



Maintaining a sustainable Future for IT in Higher Education

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Strategies for Implementation of Web 2.0 Tools in Academic Education

1. ABSTRACT

In this paper the rationale for the use of Web 2.0 tools in university instruction is provided and the aspects of EduWeb2.0 project are presented that are related to innovation, pedagogy, technology, and benefits for academic teaching staff, as well as for teachers in primary and secondary education. In addition, some of the results and experiences gained through the EduWeb2.0 project are outlined in the context of the following strategies for implementation of Web 2.0 tools: adoption, usability, maintenance, pedagogy, social interaction, privacy, security, as well as artifact integration and preservation. Conclusions are drawn regarding the future of the use of Web 2.0 tools in the context of academic instruction and new activities of the EduWeb2.0 project are announced.

2. INTRODUCTION

The use of Web 2.0 tools (wikies, blogs, RSS feed, collaborative writing, video sharing, social networks, etc.) can support innovative teaching methods and is associated with concepts like communities of practice, syndicated content, learning as a creative activity, peer-to-peer learning, the creation of personal learning environments, and non-formal education (Bartolomé, 2008). Such tools can be used to develop *Learning 2.0* strategies that can enhance student motivation, improve participation, facilitate learning and social skills, stimulate higher order cognitive skills, and increase self-directed learning (Redecker et al., 2009). A report on several European case studies indicates that the use of Web 2.0 tools has the potential for innovative active learning approaches, novel forms of blended learning scenarios, integration with social communities, collaborative creation/exchange of learning content, the introduction of diverse forms of communication, and the creation of personalized learner-centered environments like blogs and e-portfolios (Heid et al., 2009). Moreover, in the European context, the development and use of such applications and services create a considerable technological and economic potential (Lindmark, 2009).

The adoption of Web 2.0 tools at universities is facing important challenges (potential risks, institutional fear) so that an effective strategy to deal with implementation problems may include learning from (others') experience, as well as open access to content and reliance on open platforms for knowledge sharing and creation (Freire, 2008). There are numerous models for the integration of Web 2.0 in higher education (Grosbeck, 2009) whose use has both considerable *advantages* (flexibility, e-learning activities, sharing of knowledge / experiences and resources, didactic innovation, etc.) and *disadvantages* (potential problems with technology and quality of content, limited security, diversity of technologies, etc.). In addition, there are indications that students perceive the *benefits* as well as the *difficulties* arising from the use of Web 2.0 tools in university courses in comparison with the use of traditional e-learning tools and classroom lectures (Kumar, 2009).

This paper presents some of the results of the *EduWeb2.0* project in the context of *strategies for implementation* of Web 2.0 tools in academic education. The main goal of this project was to test the potential for improvement and enrichment of teaching and learning in university settings with the use of social software like wikies, blogs, and online community sites, as well as of specific tools for online note-taking, creation of mind maps and flowcharts, mashups, online presentations with an audio commentary, etc. The innovation aspects of the EduWeb2.0 project are emphasized at the beginning of this paper and highlighted throughout the text, along with its potential positive impact on the academic teaching pedagogy, use of ICT on campus, and benefits for teachers and students.

3. EDUWEB2.0 PROJECT

The EduWeb2.0 project (http://e.foi.hr/iProjekt/index.php/Main_Page) was conducted from 2009 to 2011 with the general aim of creating digital content and services in the field of education to help determine new methods and procedures for the implementation of information and communication technology (ICT) to improve teaching processes. The specific goals of the project were to investigate the potential of the educational use of Web 2.0 technologies including social software such as wikies, blogs, and online community websites, as well as tools for various forms of creative expression: mind mapping, online block-diagrams, collaborative writing, online presentations, etc. The main idea was to evaluate numerous Web 2.0 tools with educational potential and to identify a number of online pedagogical activities that could be performed with the use of Web 2.0 tools. By February 2011, the accomplished outcomes of the EduWeb2.0 project were: (1) evaluations of more than 40 Web 2.0 tools; (2) recommended online pedagogical activities with Web 2.0 tools and services; (3) workshops and lectures for teachers in Croatia; (4) case studies; and (5) scientific papers and conference presentations.

4. RELEVANT ASPECTS OF THE EDUWEB2.0 PROJECT

4.1. INNOVATION ASPECTS

One of the goals of the EduWeb2.0 project was to test different types of Web 2.0 tools in university courses. For this purpose, *online pedagogical activities* (e-tivities) were designed and tested in several hybrid courses. The variety of Web 2.0 tools used and the fact that some of the e-tivities were evaluated with a student survey reflect one of the innovative aspects of this project. Another innovation is related to the large number of Web 2.0 tools used in two courses (reported in Bubas et al., 2010b). For the course “Computer-Mediated Communication” we found that students were able to develop competencies and effectively use a number of tools for various purposes across diverse e-tivities. In this course the following types of tools were used: blogs, wikies, e-portfolios, social bookmarking, online note taking, mind mapping, block-diagrams, video sharing and tagging, online cartoon strips, mockups, mashups, and online presentations. In the “Data Structures” course the students used a wiki and four different tools from each of the following categories: online note taking, mind mapping, block-diagrams, online presentations and collaborative programming. Moreover, we developed a novel approach to peer-to-peer learning for the courses “English Language I” and “Data Structures” since the students used multiple Web 2.0 tools to present numerous course topics in a wiki to support concept development and knowledge acquisition by their peers. Finally, possibilities of using multiple Web 2.0 tools in combination with e-portfolio views and blog posts were investigated for the purpose of science promotion and popularization (Bubas et al., 2011).

4.2. PEDAGOGICAL ASPECTS

The pedagogical aspects of the EduWeb2.0 project are associated with the design, implementation and evaluation of various online pedagogical activities in several university courses. More than 30 different wiki-based e-tivities were evaluated in teaching English as a second language (see an earlier report by Kovacic et al., 2008), and so far 34 general-type e-tivities have been presented on the wiki portal of the EduWeb2.0 project¹. In addition, blog posts and e-portfolio views were evaluated as a means of presenting students’ artifacts created with Web 2.0 tools, keeping a diary of weekly course-related topics and activities, as well as of the assessment of the results of students’ work in various assignments (Bubas et al., 2011). We also investigated the usefulness of online community websites (Ning, SocialGO) for small groups of students and analyzed the effects of their use on student motivation and socialization (Bubas et al., 2010a). Many of the Web 2.0 tools were evaluated not only for their usability but also for their pedagogical potential. Some of these results are presented as brief case studies on the EduWeb2.0 project portal². Fostering collaborative and peer-to-peer learning, the enrichment of learning experiences and the development of ICT-related competencies were among the most notable educational effects of the use of Web 2.0 tools.

¹ The list of general-type online pedagogical activities and links to their description are available on this EduWeb2.0 project wiki page: http://e.foi.hr/iProjekt/index.php/E-tivities_for_Web_2.0_tools

² The list of completed brief case studies and the ones under preparation is presented on this wiki page of the EduWeb2.0 project:

http://e.foi.hr/iProjekt/index.php/Case_studies_and_practical_experiences

4.3. TECHNOLOGICAL ASPECTS

Most of the Web 2.0 tools that were used and evaluated in the EduWeb2.0 project were open-source or free of charge, web based and without the need to be downloaded or placed on a personal computer. The usability of 20 different Web 2.0 tools was tested with a comprehensive survey, along with a brief accessibility testing procedure (server response time, help included on the tool's webpage, the possibility of changing font size in the tool) that was performed for more than 30 Web 2.0 tools. Some of the best usability Web 2.0 tools were consequently recommended. For most of the Web 2.0 tools used in various courses, a brief overview was presented on the EduWeb2.0 portal with a list of *pros* and *cons* resulting from expert evaluation³. Finally, possibilities of integrating and presenting student artifacts created with Web 2.0 tools were investigated in relation to the use of a wiki (MediaWiki), blog (WordPress), e-portfolio Mahara), online community website (Ning), and Moodle LMS (to be published in Bubas et al., 2011) and presented as brief case studies⁴.

4.4. USEFULNESS AND BENEFITS

The benefits of the EduWeb2.0 project were directly associated with the development of students' ICT skills and some other competencies, as mentioned in the EU policy document "Key Competences for Lifelong Learning – A European Framework" (2006). We have developed case studies with survey evaluation and anecdotal evidence from students (i.e. Bubas et al., 2010a), presented the results of the EduWeb2.0 project at a number of conferences and lectures (including EUNIS 2010, see: Bubas et al., 2010b), and performed 5 workshops. The EUNIS 2011 report on this project will describe various strategies that were used (or are to be used) for successful implementation of Web 2.0 tools in higher education.

³ The wiki page with evaluation of Web 2.0 tools:

http://e.foi.hr/iProjekt/index.php/Evaluated_Web_2.0_tools

⁴ Examples of integration of Web 2.0 artifacts that were created by students with the use of e-portfolio views is presented as a brief case study on this wiki page (the screenshots represent views written in Croatian):

http://e.foi.hr/iProjekt/index.php/E-portfolio_use_for_presentation_of_student_assignments

5. STRATEGIES FOR USE OF WEB 2.0 TOOLS IN ACADEMIC TEACHING

A teacher who wishes to use Web 2.0 tools in academic education is likely to face several important challenges. Firstly, his/her – as well as the students' – ICT competencies may need improvement for Web 2.0 tools to be used effectively for teaching/learning. Secondly, it may be difficult to choose the most suitable and reliable Web 2.0 tool for a specific online learning activity. Thirdly, if the artifacts created by students are publicly available online (e.g. if a blog or an e-portfolio is used), the problem of student privacy may arise. Furthermore, the content placed on some Web 2.0 tools may not be permanently available online and in case a fee for using a tool (e.g. community sites like Ning or SocialGO) is charged, the access to the virtual learning environment is limited to the period of subscription. Next, the assessment of artifacts created with Web 2.0 tools may be associated with various problems like scoring criteria, plagiarism and copyright issues. In addition, the question may arise of whether to use tools freely available on the Web (Blogger, Google docs, Wikispace, FolioSpaces etc.) or install a wiki on one's own server. Finally, the use of some Web 2.0 tools may not be suitable for very small or very large groups of students, respectively. Some of those issues will be illustrated and discussed in relation to the outcomes of the EduWeb2.0 project and experiences of the project team.

5.1. ADOPTION STRATEGIES

Students who have to use Web 2.0 tools for course assignments may face various obstacles and find the activities with such tools time consuming, as well as somewhat confusing and distracting, while the tools themselves may manifest reliability and usability problems (see: Torres Kompen et al., 2009). Also, the faculty may not be aware of the benefits of using Web 2.0 technologies in education, so the factors like attitude toward such tools or possession of relevant ICT skills may also affect their intention to use them in education (Ajjana and Hartshorne, 2008).

In the EduWeb2.0 project numerous Web 2.0 tools were used in several university courses. We tried to solve the problem of adoption of Web 2.0 tools on the part of students with at least 15-30 minutes of instruction preceding the use of each tool. The students were then given simple tasks with a tool that required the same skills as the learning task that would be a part of their assignment to be submitted for assessment. In case of tools like wiki (MediaWiki), blog (Wordpress) or e-portfolio (Mahara), our students of Information Systems study required at least 30-45 minutes of instruction. We assume that less ICT-skilled students would need at least double the time to effectively manage basic tasks for creation of online content. However, for simple Web 2.0 tools for social bookmarking (Delicious), creation of mind maps (bubbl.us) or flowcharts (Glimfy) 15-30 minutes' instruction was sufficient. It must be emphasized that it is best to provide instruction on the use of a Web 2.0 tool immediately before the course related learning task is given to the students. Links to online resources that explain the use of the Web 2.0 tool (guide, help, Flash or YouTube tutorial) for later viewing are also helpful.

The EduWeb2.0 project has performed workshops⁵ for the faculty and secondary and primary education teachers (three workshops at international conferences in Croatia, one for Informatics teachers in the Northwestern part of Croatia, and one for the E-learning academy of the Croatian Academic Research Network – CARNet). These workshops were designed to inform the audience about the potential uses of Web 2.0 tools in online education as well as to develop skills in using a selected Web 2.0 tool. Our experiences from these workshops are as follows:

- a. There is a growing interest among academic teachers in Croatia for the use of Web 2.0 tools in online education.
- b. However the adoption rate in the academic community is rather slow and Web 2.0 tools are mostly used by teachers who are more sophisticated users of a traditional learning management system (LMS) like Moodle.
- c. Even the less ICT-skilled academic teachers recognize the educational potential of Web 2.0 tools in relation to innovation in instructional design and peer-to-peer learning.
- d. Adoption problems are greater if there is insufficient technological support for teachers at their college.
- e. Some participants in our workshops have adopted more than one Web 2.0 tool for their courses.
- f. Informatics teachers at the level of secondary and primary education show a great interest and a high level of technological skill, but in their concrete settings (working with classes and pupils) they observe barriers and do not recognize sufficient benefits from the use of Web 2.0 tools.
- g. Teachers at the level of secondary and primary education that have only basic ICT literacy demonstrate a very slow pace of learning how to use Web 2.0 tools and frustration in case of usability problems related to those tools.

With the purpose of informing the academic community about the potential educational uses of Web 2.0 tools several lectures and a webinar were delivered at the University of Zagreb. Also, selected Web 2.0 tools are presented on the project website in English⁶ and Croatian⁷ language. Case studies and practical experiences with the use of Web 2.0 tools in education are currently being placed on the project wiki pages⁸. More workshops, presentations and other dissemination activities are planned for the year 2011 and beyond. Finally, with the help of students, a separate online tutorial in Croatian is currently being created for most of the Web 2.0 tools covered.

⁵ The wiki page with the list of workshops and presentations related to the EduWeb2.0 project: http://e.foi.hr/iProjekt/index.php/Workshops_and_project_related_presentations

⁶ http://e.foi.hr/iProjekt/index.php/Evaluated_Web_2.0_tools

⁷ http://e.foi.hr/iProjekt/index.php/Evaluirani_Web_2.0_alati

⁸ http://e.foi.hr/iProjekt/index.php/Case_studies_and_practical_experiences

5.2. USABILITY STRATEGIES

The use of Web 2.0 tools in higher education should not create barriers and students should be observed by the instructors in the use of those tools to identify problems related to usability (Collis and Moonen, 2008). In our paper presented at the EUNIS 2010 conference (Bubas et al., 2010b) we presented a detailed model for evaluation of Web 2.0 tools that are used for educational purposes. During the academic years 2008/2009 and 2009/2010 we encountered several usability problems with Web 2.0 tools that were used in the “Computer-Mediated Communication” course. Several examples of problems will be explained in more detail in this section.

The most severe problem was related to the tool Nanolearning that the teaching assistant failed to test before using it in class. This tool was not functional and the request to create online course material resulted in the loss of artifacts that had been created with this tool by the students. As a result, the teacher’s credibility was questioned even though the students appeared to be quite benevolent concerning this issue. On a positive side, the study group involved was rather small (15 students), and the lesson learnt by the teacher was to always test Web 2.0 tools prior to using them for student assignments and to evaluate the use of the tools in a small study groups (10-25) before using them in large groups (for instance, in classes with 100 or more participants).

Some usability problems were also encountered with the Web 2.0 tool for the creation of online comic strips [Bubblr](#). The students had difficulty in signing-up and saving their work, as well as retrieving the saved comic strips.

In cases of slow Internet connection, the use of the Web 2.0 tool for the creation of mind maps [bubbl.us](#) required too much time for registration. On several occasions this process was never finished so that the students were not able to save their work.

Several conclusions regarding usability that we reached after the use of various Web 2.0 tools were:

- a. A Web 2.0 tool should be thoroughly tested before students are required to use it for assignments.
- b. A new type of Web 2.0 tool should ideally first be used in small study groups (10-15 students) before large groups of students (50-100 or more) are given assignments with that specific tool.
- c. For tools that are freely available on the Web (when the service provider is not located on campus) the teacher should have an alternative in case of inaccessibility of the tool or a sudden switch to a paid service (for instance, we experienced problems when a mind mapping tool was not accessible due to server failure at the moment the instruction on performing a task was being given to students; on another occasion, a free flowchart tool started to require monthly subscription for individual use; also, the online community tool Ning turned from no-cost to prepaid service and we decided to purchase a subscription for two groups of students). Such experience led us to, whenever possible, offer alternative tools when giving an assignment to students like the creation of a mind map ([bubbl.us](#), [Mindomo](#)) or [mashup](#) ([iGoogle](#), [PageFlakes](#)).
- d. Teachers should exchange their experiences with the use of various Web 2.0 tools regarding their usability attributes like ease of use, navigability, learnability, and reliability.

In order to objectively identify the best Web 2.0 tools regarding their usability in educational settings and to enable other teachers to profit from our experience with such tools we have developed a comprehensive usability evaluation survey (with more than 40 different usability attributes). For the study presented at the EUNIS 2010 conference (Bubas et al., 2010) we have performed a detailed usability evaluation for 16 tools in the following categories (four tools were examined in each category): online note-taking, block diagrams, mind mapping, and video podcasting. In the “Data Structures” university course during the academic year 2009/2010 we asked the students to use Web 2.0 tools in the aforementioned four categories for several assignments. Based on the students’ responses to selected usability survey questions at the end of semester the best performing tools were identified for each of the four categories, respectively: Google docs, Gliffy, Mindomo, and SlideSix. These are the tools that we have used in several university courses in more than one academic year and the ones that we can recommend for use in university education. These four best performing tools regarding usability were marked on the list of the evaluated Web 2.0 tools on the wiki page of the EduWeb2.0 project. The future goal of the EduWeb2.0 project is to further analyze Web 2.0 tools regarding their usability in the educational context and to advance the methodology for evaluation to provide not only information to teachers, but also guidance for developers of such tools.

One of the main EduWeb2.0 project goals was to perform expert evaluation of at least 40 different Web 2.0 tools and to present the results of the evaluation on the project wiki pages⁹. As a result, more than 50 tools belonging to the following *categories* were used in several university courses at the Faculty of Organization and Informatics, University of Zagreb: online note-taking, mashups, collaborative Google applications, user interface design, social bookmarking, mind-mapping, block-diagrams, online presentations/video podcasting, audio podcasting, collaborative programming, online photos & comic strip creation, online surveys, voice recording & publishing, social networking, e-portfolio, wikies and blogs. The evaluation of the tools was performed by teaching assistants (doctoral students) who are ICT experts and highly skilled in using educational technology. Useful information obtained for each tool is presented in English and Croatian on separate wiki pages of the EduWeb2.0 project, together with *pros & cons* for the use of a particular tool and links to online help and tutorials¹⁰. Considering their importance for the creation of online educational content two other categories of tools were also evaluated even though they were not used for student assignments: video editing tools (Photobucket, YouTube Remixer, Videotoolbox, etc.) and screen and sound capture tools (Free Screen Recorder, AutoScreenRecorder, etc.).

Finally, *accessibility testing* was performed for almost all of the evaluated tools regarding *server response time*, help information or tutorial included on the tool's webpage, and possibility of changing font size in the tool. The results of these accessibility tests are placed in the EduWeb2.0 project wiki at the bottom of the evaluation page for each tool.

⁹ Link to the list of evaluated Web 2.0 tools:

http://e.foi.hr/iProjekt/index.php/Evaluated_Web_2.0_tools

¹⁰ An example of evaluation information provided for the Mindomo tool for online creation of mind maps is presented on this wiki page: <http://e.foi.hr/iProjekt/index.php/Mindomo>

5.3. MAINTENANCE STRATEGIES

One of the important decisions of academic teachers who intend to use Web 2.0 tools in their courses is whether to use their own (college/university) server for tools like wiki (e.g. MediaWiki), blog (e.g. Wordpress), e-portfolio (e.g. Mahara), or social network (e.g. Elgg.org), or to use tools and services that are either free, or available on the Web at a small charge (e.g. WikiSpaces, Blogger, Foliospaces, Groups).

The use of one's own or college/university server means that IT support is also ensured or that the teacher has expertise in management of open source software solutions with at least some knowledge of system administration. For the EduWeb2.0 project such institutional support was provided by the *Center for Informatics Support* within the College. Also, the project leader had a separate server for e-learning projects. This enabled the installation of several wikies (MediaWiki) used in different courses and a blog (Wordpress) used in the "Computer-Mediated Communication" course, as well as of a mobile wiki and a content management system (CMS) for mobile learning. However, open source software solutions require upgrading, and regular server administration is also needed.

The use of the e-portfolio system Mahara was enabled both by the College and the Center for E-Learning at the University of Zagreb. It is our opinion that university solutions should be more stable in the long run than those that are placed on a college server. For instance, we experienced a change of the domain name for the college Mahara e-portfolio system, which made all the views to student artifacts inaccessible in cases when they used a secret URL to create links to their content.

On the other hand, we also used the publicly available Web 2.0 tools and services (bubbl.us, Gliffy, Bubblr, SlideSix, iGoogle, Zoho applications, etc.), although there was no assurance that the content placed on free online Web 2.0 tools/services would be accessible for a longer period of time. Even though such open and free web solutions required no maintenance effort or cost, in many cases we wanted to preserve the best artifacts that were created by the students for peer-to-peer learning. Therefore the students were asked to create JPEG files, screenshots, and other forms of backup and upload them into a blog, wiki or e-portfolio system that was placed on a local server and maintained by the college or university IT support staff.

Therefore, for those university teachers with less IT support from their institution, poor long-term funding opportunity and lack of expertise in the field of installation procedures for open source solutions and/or server system administration we would suggest that freely available Web 2.0 tools are used in combination with a college/university LMS or e-portfolio system. On the other hand, teachers who have more opportunity to install, adapt and run their own open source Web 2.0 solutions can benefit from a greater stability of created content, but should take into account the need to upgrade their systems (blogs, wikies, e-portfolios) to avoid security risks.

5.4. PEDAGOGICAL STRATEGIES

The basic pedagogical strategy that was used in the EduWeb2.0 project was to create interesting and illustrative *online learning activities* (e-tivities) with the use of Web 2.0 tools that would engage the students and create an opportunity for collaborative learning based on cognitivist and constructivist principles. In some cases the intention was also to use the artifacts that one group of students had

created for formal and informal learning by other student groups. The Engwiki project (Kovacic et al., 2008) best illustrates such an approach. The e-tivities¹¹ that the students performed in the Engwiki project resulted in the creation of content which other students would be able to use for informal learning and broadening their knowledge of topics ranging from English grammar through IT history and concepts to various general topics like mass media, marketing etc.

However, in the EduWeb2.0 project students were also asked to use several Web 2.0 tools to illustrate their seminars and course related projects on specific topics. For instance, in the 2009/2010 and 2010/2011 academic years student assignments related to the “English Language I” course (led by Andreja Kovacic) involved the explanation and illustration of specific elements of English grammar by combining the use of Web 2.0 tools for making mind maps, flowcharts, cartoon strips, publishing presentations, and tagging a video¹². In this case the wiki pages served to provide basic theoretical content and connect the artifacts created with other web 2.0 tools. More than 40 elements of English grammar have been illustrated so far with the use of two or more types of Web 2.0 tools, making it an example of course assignments that are given to more than one generation of students that result in artifacts with the potential for peer-to-peer and informal learning. In case of the “Data Structures” course students also used various types of Web 2.0 tools to illustrate algorithms and provide a means for learning programming for other students (i.e. they created not only the solutions to specific programming problems, but also tutorials for other students of future generations). Placed on a wiki, their solutions were made accessible to the general public as well. The Web 2.0 tools that were used in the “Data Structures” course in the academic year 2010/2011 are presented in Figure 1.



Figure 1. The variety of Web 2.0 tools used for the course Data Structures in the 2010/2011 academic year.

¹¹ Link to categories of e-tivities: http://e.foi.hr/engwiki/index.php/Pool_of_e-tivities

¹² Link to grammar e-tivities with Web 2.0 tools:
http://e.foi.hr/engwiki/index.php/Grammar_Web_2.0

It must be noted that evaluation of courses, lectures and pedagogical activities is an important element of effective instructional design. Therefore the effects of the use of Web 2.0 tools and corresponding online pedagogical activities should be examined with a student survey. For instance, most of the e-tivities that were designed for the “English Language I” course were evaluated by the students who had to perform them. In case of the “Computer-Mediated Communication” course the use of Web 2.0 tools was evaluated in terms of their usefulness for learning course content and other educational effects.

One positive effect of the use of Web 2.0 tools is related to the retention of course content. In case of the “Computer-Mediated Communication” course, students were provided with a non-moderated *E-learning 1.0* based course entitled “Online Communication” that was based on theoretical texts, illustrations, quizzes, tests, and self-assessment questionnaires. Also, in accordance with the *E-learning 2.0* paradigm, they had to perform learning activities and create artifacts with various Web 2.0 tools to post them on their blog. When they were asked what enabled more permanent knowledge acquisition or *long-term memorizing* (i.e., the ability to remember course content several months or years after learning activity) almost all of the surveyed students (N=51) reported a greater advantage in the use of Web 2.0 tools (see Figure 2).

The results presented in Figure 2 illustrate the positive effects that greater engagement of the teacher and students in designing and performing of learning activities with Web 2.0 tools may have on retention of course content. Our other findings indicate that positive effects can also be found in the activation of higher levels of cognitive learning (*synthesis, analysis and evaluation*) and a greater degree of the so called *deep learning* (versus *surface learning*).

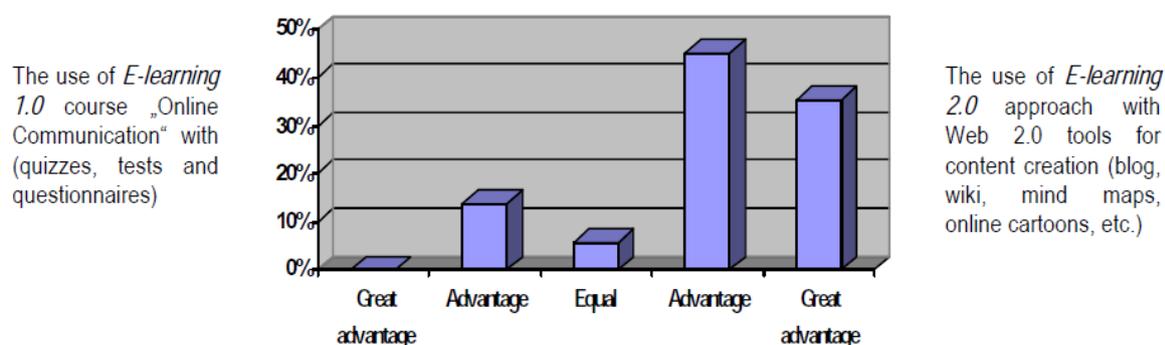


Figure 2. Student responses to the question of which approach enabled more permanent knowledge acquisition or long term memorizing (ability to remember course content several months or years after learning activity); N=51

An important element of the use of Web 2.0 tools in education is the selection of suitable pedagogical activities. To facilitate this process for teachers of various courses we have collected and adapted more than 30 general-type e-tivities and presented them on the EduWeb2.0 project wiki¹³.

¹³ The links to e-tivities of general type:

http://e.foi.hr/iProjekt/index.php/E-tivities_for_Web_2.0_tools

These e-tivities were classified into the following categories: (1) attention and motivation/session openers; (2) directing/focusing/guidance; (3) concept development/cognitive learning; (4) knowledge acquisition/practice; (5) constructivist teaching and learning; (6) group conversation/idea generation; (7) collaborative learning/peer learning.

We can summarize the pedagogical strategies regarding the use of Web 2.0 tools in several principles:

- a. The suitable Web 2.0 tools should be selected on the basis of their potential effectiveness to attract interest, engage students and better illustrate the course content.
- b. Use of Web 2.0 tools and related pedagogical activities should be evaluated with the intention of improvement of instructional design with next generations of students.
- c. Web 2.0 tools can be utilized to facilitate collaboration and peer-to-peer learning; more than one generation of students can participate in the development of course related online content that can be used as support for the students currently enrolled in a course and informal learning.
- d. Even though the use of Web 2.0 tools may be time consuming for the educator and students, positive effects regarding retention and higher order cognitive learning may be more important.

For the use of ICT to stimulate deep (higher order) learning it is important to effectively design the virtual learning environments to facilitate socializing and develop collaboration skills, use more elements of experiential (active, constructive, reflective) learning, and shift toward learner independence with the use of discovery- and problem-orientated learning tasks (see: Abbot et al., 2009).

5.5. SOCIAL INTERACTIONS STRATEGIES

For the EduWeb2.0 project we have used several tools that enable social interaction among students: wiki, blog, e-portfolio, online community sites (Ning, SocialGO), collaborative programming tools (e.g. Bytemycode, Pastebin), and collaborative Google applications. Depending on the number of students enrolled in a specific course, the size of groups that used a certain type of Web 2.0 tools enabling social interaction varied from 16 to 180 students.

For smaller groups (15-40 students) we found that tools like wiki, blog, e-portfolio and online community sites (Ning) functioned well concerning peer-to-peer learning and collaboration in pairs or small teams. However, in most cases the level of social (non-task) interaction with the use of such tools was rather low (except for the Ning tool). Students who used social networks like Facebook and met face-to-face every day in class were less likely to need to socialize with the use of such tools. However, in two cases we found a considerable degree of spontaneous socializing activity.

At the Faculty of Electrical Engineering, University of Zagreb, the e-portfolio system Mahara was used in the 2009/2010 academic year with a group of students of the fifth year of the Bologna study who had never used such a tool. The students spontaneously created groups within the e-portfolio system that were related to different departments (Telecommunications, Industrial Electronics, Electroenergetics, etc.) and established friends' networks.

Two study groups (N1=16; N2=30) of part-time students of the “Computer-Mediated Communication” course (in the 2009/2010 academic year) used the online community site Ning with features like personal profile page, blog, forum, chat, photo and video sharing. At the end of the course the students stated that the use of this tool enabled them to get to know each other better, share learning resources, knowledge and experience, get/provide help, etc. They found this learning environment to be stimulating both for learning and socializing activities (see: Bubas et al., 2010a). However, with the majority of large study groups with more than 100 students we did not find that the use of wikies, blogs, and e-portfolio systems facilitated social interactions. Furthermore, it is our opinion that for such large groups the Ning tool would be inconvenient as it would not enable proper control over artifacts created by students and a proper environment for assessment. On the other hand, we found that for large study groups the use of e-portfolio views was the best means for presentation of artifacts created by students.

According to our experiences, the strategy recommendations related to the use of Web 2.0 tools for socializing in hybrid courses would be as follows:

- a. For small groups of part-time students online community sites like Ning can facilitate social interaction, collaboration, and informal peer-to-peer learning during the course.
- b. Medium-sized groups (50-100 students) can effectively use collaborative features of the wiki or blog tool, but more socializing activity could be expected with the use of e-portfolio systems like Mahara, which enable spontaneous creation of groups and friend associations between learners.
- c. When students are faced with tight deadlines and work overload they will probably reduce the level of peer-to-peer and informal learning from the artifacts that were created by other students, as well as limit the unnecessary socializing with Web 2.0 tools that are used for course related activities.
- d. When socializing features are combined with the potential for effective online presentation of student work, the e-portfolio system Mahara probably outperforms other popular tools like wiki or blog.
- e. When the goal of the course is student collaboration and production of publicly available content, the use of a wiki is more effective than the use of a blog, and the use of e-portfolio is perhaps least suitable for this purpose.

Finally, it is worth mentioning that, even though such tools were not used for the EduWeb2.0 project, according to literature (e.g. Ebner et al., 2010) *microblogging* with Twitter or similar tools has the potential to initiate and facilitate interaction among learners in virtual environments and support informal learning.

5.6. PRIVACY STRATEGIES

With the introduction of social networks like Facebook and MySpace the notion of online privacy was taken to a new dimension. However, in institutional education the privacy of students should be protected (see: Aïmeur and Hage, 2010). In the EduWeb2.0 project students created online content that was publicly available with the use of a wiki or a blog. Even though in some cases they signed their online artifacts, there were no reports of related privacy violation or online stalking in any of the courses that used Web 2.0 tools for learning activities. However, to avoid privacy violation problems we decided that the students would use only their first name and their surname initial for

their online identity. They were allowed to use the same account name in their wiki or blog posts as well as for creation of anonymous mail accounts that enabled registration needed for their use of free Web 2.0 tools and services.

A classical means for privacy protection is the use of a pseudonym. The rules for creating accounts for working with Web 2.0 tools were:

- a. Create an account on Yahoo and Google services.
- b. Do not specify the full name when creating an account with a mail service.
- c. Do not specify the full name when creating an account to work with Web 2.0 tools
- d. The recommended format of the account information was:
 - First Name: Goran, Ana (your full name)
 - Last Name: Bb, Cr (first 1 or 2 letters of last names without vowels)
 - Username: GoranBb, AnaCr
 - Password: grnbbs123, ancrc123 (a combination of letters, names and numbers)
 - Do not tie a user name and password for Web 2.0 tools with your official e-mail at the college or your personal Yahoo! or Gmail account.

To protect the privacy of students we decided to use the Moodle wiki functionality instead of the public MediaWiki, as in cases when the students needed to select assignments by signing up for available topics, as well as in other self-organizing activities. The MediaWiki was used when the goal of the course was the creation of publicly available content. In the 2010/2011 academic year we tried to limit the publicly available content to those artifacts that were signed with a pseudonym in which the last name of the student was not recognizable by persons outside the study group. Also, the use of e-portfolio views enabled the students to create a diary of weekly course activities that was not accessible from the public web, as in the case of blog posts.

To conclude, a privacy policy for students should be determined at the institutional level, as well as communicated and negotiated with the students in each course. The basic privacy preserving procedures should also be communicated to the learners, like those associated with cookies and browser history, and perhaps also other issues like disabling of Flash cookies, use of firewall and anti-spyware. Teachers should check the privacy policy of the Web 2.0 tools that they plan to use with students to ensure that their owners do not misuse or reveal personal information to third parties.

5.7. SECURITY STRATEGIES

Web 2.0 applications are more susceptible to security vulnerabilities than traditional Web sites, primarily because their functioning relies on the execution of scripts. Each script can run malicious code thus enabling hackers to launch denial-of-service (DoS), phishing, and similar attacks (Lawton, 2007). Davidson and Yoran (2007) have proposed a concept of *Security 2.0* that will follow collaborative patterns of Web 2.0. OWASP is a project that tri-annually announces a list of ten most critical security risks¹⁴ related to the development and use of web applications. Hereafter these threats will be listed in the context of Web 2.0 applications along with strategies for their prevention:

- a. Injection flaws occur when an attacker embeds the untrusted data into the syntax of the targeted interpreter.
- b. Cross Site Scripting (XSS) occurs when a hacker injects specially designed code within the dynamically generated and legitimate Web 2.0 application. Since blogs, social networks, and wikies allow users to input formatted content, they are especially vulnerable to XSS attack.
- c. Broken Authentication and Session Management – since Web 2.0 applications allow users to manage data, there is a great chance that less-experienced ones will expose their account information or session tokens.
- d. Insecure Direct Object References flaw occurs during the development of Web 2.0 applications, and allows an attacker to gain the unauthorized access to objects such as files, directories, database keys, etc. through manipulation of reference.
- e. Cross-Site Request Forgery (CSRF) is a vulnerability that exploits trust established between a user and a Web 2.0 application. The attacker creates forged XMLHttpRequest and injects it into a malicious site together with the code for automatic load and run. Accordingly, the attacker tries to trick a victim to run malicious URL. As a consequence the attacker is allowed to perform any activity on the vulnerable web application the victim is authorized for.
- f. Security Misconfiguration – an attacker will exploit this flaw in cases when both developer and user do not follow examples of good practice related to the security configuration at all levels of a Web 2.0 application.
- g. Insecure Cryptographic Storage flaw can be exploited in cases when weak encryption algorithms are employed to protect sensitive data. The consequence of this type of flaw is identity theft and similar frauds.
- h. Insufficient Transport Layer Protection is exploited when the confidentiality and integrity of sensitive network traffic are not adequately protected. As a consequence, the attacker can steal a user's session cookie or gain the access to passwords and other private data by conducting a phishing attack.
- i. Unvalidated Redirects and Forwards allow the attacker to create a URL which will: (1) redirect the user to a malicious application that performs a phishing attack; (2) collect the user's account and other sensitive information and thus gain unauthorized access.

¹⁴ OWASP: The Ten Most Critical Web Application Security Risks. Retrieved on 5th May 2011, URL: https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project

According to the WhiteHat Security¹⁵, 64% of websites experienced at least one information leakage (as a consequence of a security misconfiguration flaw) and Cross-Site Scripting vulnerability in the year 2010.

The list of security threats that are associated with the use of Web 2.0 tools emphasizes the need for proper maintenance of institutional IT resources (servers, software), as well as of computer systems that are used by students. However, in reality, most students in the classroom will rarely use a firewall other than that included in the operating system and will not be sufficiently informed about most security-related threats.

6. CONCLUSION

The use of Web 2.0 tools in academic education extends the limits of classical LMSs (Moodle, Blackboard) regarding the potential for social interaction, collaboration and novel forms of information presentation. Current trends in cloud computing, social networking, collaborative use of web based document processing applications (Google docs), introduction of Google Chrome Operating System, growth of mobile technology, and the variety of Web 2.0 tools and application that are appearing on the Internet create pressure on academic educators to examine the potential of such technologies for creating innovative, more attractive and effective learning environments. The EduWeb2.0 project will continue to investigate novel Web 2.0 tools and pedagogical activities for their potential usefulness and appropriateness in online education. Currently, we are experimenting with a combination of a mobile CMS and wiki, as well with models for science communication/popularization with the use of Web 2.0 artifacts integrated in e-portfolio views and blog posts. The strategies that are presented in this paper are therefore only a limited set of recommendations and experiences that have resulted from the EduWeb2.0 project.

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