Evaluation of Web 2.0 tools in the e-learning context: Case studies related to pedagogy and usability

Goran Bubas[1], Tihomir Orehovacki[2], Igor Balaban[3], Ana Coric[4]

University of Zagreb, Faculty of Organization and Informatics, Pavlinska 2, 42000 Varazdin, Croatia.
[1]goran.bubas@foi.hr [2]tihomir.orehovacki@foi.hr [3]igor.balaban@foi.hr [4]ana.coric@foi.hr .

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1. ABSTRACT

The potential uses of Web 2.0 tools are investigated in case studies of several hybrid academic courses with an emphasis on their usability and potential for improvement of pedagogy (creativity, collaboration, peer-to-peer learning, etc.). More than 35 different Web 2.0 tools were included in courses in the 2009/2010 academic year and for 20 of them a detailed usability survey was performed. Conclusions are made regarding the choice of Web 2.0 tools for academic education, the integration of artifacts produced by the students in wiki, blog, online community tools, e-portfolio, or Moodle LMS. These activities were performed as part of the EduWeb2.0 project and are discussed from the aspects of technology, pedagogy, innovation, and usefulness.

2. INTRODUCTION

E-learning 2.0 (Downes, 2005) is a recently introduced concept that aims to integrate some of the newer trends in teaching and learning with the use of Web 2.0 tools (wikies, blogs, social bookmarking tools, online community tools etc.). Educational use of Web 2.0 tools is often placed in the context of pedagogical approaches like student-centeredness, learner autonomy, community of practice, learning community, collaborative learning, etc. (for instance, see: Gonzalez and St. Louis, 2008). The use of Web 2.0 tools is not limited to the social effects of learning, but can also support higher-order thinking according to the Bloom's taxonomy (Burns, 2009). Constructivism is the most popular paradigm associated with *E-learning 2.0*, and some other related and innovative conceptualizations include *social learning 2.0, micro learning, nano-learning, University 2.0, Curriculum 2.*0, and *Pedagogy 2.0* (McLoughlin and Lee, 2008b). One of the potential positive effects of the introduction of social software like wikies and blogs in online learning is a pressure on educators to reconceptualize their view of teaching and learning (McLoughlin and Lee, 2008a).

Redecker et al. (2009) have summarized some of the contributions of the use of Web 2.0 tools in the areas of technological, organizational and pedagogical innovation, but they also emphasize the challenges inherent in E-learning 2.0: digital divide (regarding internet access, digital skills and advanced digital competence); problems that are encountered by students with special needs and disabilities; new pedagogical skills needed by educators; copyright issues; concerns regarding preservation of privacy and unwanted advertising/spamming; uncertainties regarding the reliability of user-produced content and preservation of data in case of external service providers. Even though there are numerous models for integrating Web 2.0 tools in higher education, it must be noted that such innovation in e-learning can have both advantages and disadvantages (Grosseck, 2009). A recent case study of the use of multiple Web 2.0 tools in the creation of personal learning environments (PLE) has indicated that such activities can be time-consuming, distractive and confusing to students, and that the use of Web 2.0 tools could suffer from technology and adoption problems (Torres Kompen et al., 2009). The adoption problems associated with Web 2.0 tools in education are related not only to students, but also to university teachers, even though some educators expect that their use could improve learning outcomes, interaction with peers and satisfaction with the course (Ajjana and Hartshorne, 2008). Finally, there are not many studies in literature on potential technical problems and usability of Web 2.0 tools even though evidence exists that some of their developers may be disregarding good design practices (Pilgrim, 2008).

To address some of the above mentioned issues an e-learning project was conceptualized that would test the applicability and usability of various Web 2.0 tools in a hybrid academic educational environment. The project entitled *EduWeb2.0* was started in 2009 with the main intention to test a large number of Web 2.0 tools in concrete courses at the university level.

3. THE *EduWeb2.0* PROJECT BACKGROUND

The *EduWeb2.0* project is a one-year project funded by the Ministry of Science, Education and Sports of the Republic of Croatia that is conducted at the Faculty of Organization and Informatics, University of Zagreb. In some way it is an extension of the *Engwiki* project that was presented at the EUNIS 2008 conference (Kovacic et al., 2008). However, in the *Engwiki* project only a wiki system was used to develop and implement more than 25 online activities (e-tivities) in teaching English as a foreign language, while the idea of the *EduWeb2.0* project was to test up to 50 different Web 2.0 tools (and present the experience with their use through brief case studies) rather than develop various e-tivities for their application in a specific course.

3.1. Previous experience with the use of Web 2.0 tools in the hybrid course "Psychology and the Internet"

The main idea for the use of different Web 2.0 tools in one university course dates back to the 2005/2006 academic year and the hybrid university course "Psychology and the Internet" which combined classroom teaching with a traditional (E-learning 1.0) online course and the use of wiki, blog and the social boomarking tool *Delicious*. The use of a wiki system and a blog in this hybrid course enabled various educational outcomes that justified the effort invested in the use of novel technology (Bubas and Kermek, 2007). For instance, since the students were co-creators of the course content, the effects related to the use of a wiki to develop an online glossary and support course related activities resulted in the development of vocabulary and concepts, peer-to-peer learning, personal web publishing, collaboration, orientation toward public interest, greater sense of responsibility and increased feeling of empowerment. Similarly, for many students the use of a blog tool provided a greater potential for expression of their creativity, online interaction through comments of blog posts, feeling of social presence, peer-to-peer learning, enriched learning experience, greater motivation for learning, storytelling, web publishing, and potential for self-reflection (comparable to the use of an e-portfolio). However, some problems were evident regarding the use of the wiki and blog tools. First, it presupposed the need for technical support and a web server to install a wiki and blog tool. Second, a reasonable level of instruction was needed for students to be able to effectively create wiki pages, whereas the blog tool required even more training owing to a more complicated user interface that was not intuitive for students. Also, the blog tool worked very slowly after a large number of photographs were uploaded and when the local computer network would slow down. The wiki and blog tool required maintenance by a system administrator. Finally, the blog tool proved to be inadequate and was not used in other courses. In the evaluation of the elements of the hybrid course the wiki tool was evaluated as highly as traditional lecturing, the Web CT component of the course and the special e-course on online communication and psychology of internet users. However, the blog tool was rated less favorably by the students in relation to other components of the hybrid course. There was no misuse of the wiki and blog in form of inappropriate content, except in one case when a student placed links to photographs of bikini models on several wiki pages. As a consequence, one student was asked to monitor the newly created and edited wiki pages, which solved the problem. It must be noted that the access to the wiki at that time was without login or other restrictions.

3.2. Previous experiences with the use of a wiki system in several courses

The wiki tool was used in the course "Organizational Communication" in 2005/2006 and 2006/2007 academic years. The students created a glossary related to the course content and posted their written assignments on wiki pages. They found the wiki easy to use but did not develop much interest in this technology. There were no instances of misuse of the wiki even though no login was required for creating and editing of wiki pages. However, there were several instances of plagiarism when students copied theoretical content that they found on the web on the wiki pages of their assignments. In one case a student scanned a textbook with optical character recognition (OCR) software and placed the content on the wiki page of his assignment.

The wiki tool was also used in the course "Customer Relationship Management" (CRM). The wiki was particularly convenient for organizational activities like reservation of assignment topics, scheduling student presentations and alike. In this course the wiki was predominantly used for project activity. In

the academic year 2007/2008 the students of the CRM course had to develop a wiki site with the theoretical content related to the topic of university CRM whereas in the 2008/2009 academic year they developed another wiki site devoted to the topic of a CRM of a SME (concretely, a printing company). These projects enabled the students to work on their own potentially practical solutions and engage in a type of learning that is associated with cognitivist and constructivist pedagogical approaches. However, a new wiki system had to be installed for each of the two academic years. No instances of misuse of the wiki system were observed even though there was no login and there was open access to the wiki systems. At the end of 2007/2008 academic year the spambots started to insert external links in wiki pages (including talk/discussion pages), probably to improve search engine rankings of commercial websites. This meant that the wiki engines used in previously mentioned courses needed to be upgraded and that a login had to be enabled as a requirement for the creation and editing of wiki pages.

The *Engwiki* project started in the academic year 2006/2007 and by the academic year 2009/2010 more than 25 online pedagogical activities (e-tivities) had been designed and evaluated that used the wiki system for teaching English as a foreign language (EFL). This project proved that online pedagogical activities with a wiki system could effectively supplement traditional EFL teaching and that some types of e-tivities are more suitable for the online environment than others. Also, the designed e-tivities were found to be useful to other foreign language teachers who were interested in computer-aided language teaching. Some of the results of the EngWiki project were reported at the EUNIS 2008 conference (Kovacic et al., 2008) and information on this project can be found on the project website.

4. THE RESULTS OF THE *EduWeb2.0* PROJECT

The main results of the EduWeb2.0 project can be derived from the use of various Web 2.0 tools in several hybrid academic courses:

- In the course “Computer-Mediated Communication” several groups of students performed assignments in up to 18 different Web 2.0 tools and presented their artifacts in a blog tool, online community tool Ning, and e-portfolio tool Mahara.
- In the course “Data Structures” a comprehensive usability evaluation was performed of 20 Web 2.0 tools and novel forms of peer-to-peer learning of course content were investigated.
- In the course “Business English” several Web 2.0 tools were used for visualization of selected topics from English grammar and collaborative learning.

4.1. The use of multiple Web 2.0 tools in the hybrid course “Computer-Mediated Communication”

The hybrid course “Computer-Mediated Communication” started in the 2008/2009 academic year with a group of 18 students of Information Systems at the Faculty of Organization and Informatics, University of Zagreb. The teacher was Goran Bubas (with assistance from Tihomir Orehovacki, Igor Balaban and Tonimir Kisasondi). This hybrid course was delivered through traditional classroom lecturing and several online components. First, all of the lectures (MS PowerPoint slides and articles in MS Word) were placed in a Moodle learning management system (LMS), which served as a depository of the learning content. This hybrid university course also had a separate non-moderated e-learning course named “On-line communication” with 6 chapters and 34 subchapters on various topics including online communication technology and communication skills, computer literacy, motivation for Internet use, Internet addiction, use of the Internet for finding information and learning, as well as security and privacy related behavior of Internet users. During their participation in the “Computer-Mediated Communication” course the students maintained a wiki glossary related to the course content and used a blog tool to keep a diary of their online activities in computer lab sessions. During their excercises in a computer lab the students learned about various Web 2.0 tools that can be used for the following purposes: social bookmarking (Delicious), mind-mapping (bubbl.us), block-diagrams (Gliffy), online comic-strip creation (Bubblr), online surveys (JotForm), collaborative writing and document sharing (Google docs), online presentations / video podcasting (Slidestory, Veotag), online notes taking (Notemesh), online learning objects (Nanolearning). With most of those tools the students had to perform simple activities and create online content that was related to the theoretical topics of the course. Our most important experiences with the use of various Web 2.0 tools in the academic year 2008/2009 were both positive and negative:

- The wiki tool *MediaWiki* that was placed on the college server proved to very reliable, easy to use and good for organizational activities (reservation of assignments, scheduling of student presentations, etc.). Also, the wiki glossary was used to create links to explanations of concepts that were used in the text of the projects which students placed in their blog.

- The blog tool *WordPress* required more technical skill than the wiki, but enabled the students to create visually effective online content. The students had to use the blog tool to write an online "diary" of weekly course related activities and create their final project (theoretical text / report / essay).

- The social bookmarking tool *Delicious* proved intuitive and easy to use but the students did not show much interest in using the tool for creating their online collections of links and they only used it to complete an obligatory course assignment.

- The mind-mapping tool *bubbl.us* was quick to learn (5-10 minutes) and enabled very effective visualizations of the theoretical content. However, there were some problems with user registration and saving the created mind maps.

- The block-diagram tool *Gliffy* was not very intuitive and it required more time (10-15 minutes) to learn the basic functionalities. It was very good for creation of process diagrams related to the course content (use of various online communication tools) and description of online communication skills.

- The online comic-strip creation tool *BubbIr* had a poor image search function and it sometimes took students a lot of time to find useful *Flickr* photos this tool utilized. The comic-strips were used in computer lab exercises to illustrate online communication skills and different course related topics.

- The tool for the creation of online surveys *JotForm* was intuitive and quick to learn (5-10 minutes). It has a very good user guide and is practical for short online survey forms. It was used by the students to create surveys related to behavior of Internet users.

- The creation of online presentations (with audio) from photos or PowerPoint slides was performed with a tool named *Slidestory* that required a local installation of free software. This means that a login with the administrator account is needed for each computer installation, which is not convenient when college computer labs are used. Also, for unknown reasons, some students were not able to upload/synchronize their audio files with photos/slides. The Slidestory tool needed more computer skill than any of the previously mentioned tools. The related tool for tagging of video files *Veotag* was both intuitive and easy to learn. However, this is a commercial tool with free basic service for 30 days.

- The collaborative online note-taking tool *Notemesh* was used before a midterm exam with an instruction to students to create and share notes related to the exam content. To be able to create notes and collaborate, the students needed to register a course for notes sharing in Notemash and ensure separate registration for each participant. Most of them did not develop much interest in this voluntary online activity and the use of this tool was abandoned in the next academic year.

- In one online activity the students were asked to use a tool for the creation of learning objects (brief e-learning lectures) named *Nanolearning*. The Nanolearning tool manifested basic reliability problems that resulted in data loss and therefore caused frustration for both the students and the teacher. This outcome illustrates what can happen when a Web 2.0 tool is used in class without serious prior testing/evaluation.

The artifacts that the students produced with Web 2.0 tools were visible to all the other students who were enlisted in the course "Computer-Mediated Communication" since all of them had to keep an online diary with a blog tool *WordPress*. Each time a student created some Web 2.0 artifact in class or as a homework assignment, they had to place a link to the artifact (or embed it) in their blog post with a title that consisted of the date of the classroom lecture or the exercise in the computer lab.

For their final online activity the students had to create a theoretical text (i.e. report/essay) on a specific topic in 1-3 blog posts (this was their "project"). The written reports/essays were related to course topics and in their blog posts the students had to create artifacts with different Web 2.0 tools that supplemented and illustrated the text of their "project". For instance, such a "project" on the topic of online games could include a mind-map (bubbl.us) of a typology of online games, a block-diagram (Gliffy) of a specific strategy for an online game player, a comic-strip (Bubblr) of some online gaming issue, an online survey (JotForm) for other students about participation in online games, an online presentation (Slidestory) about several online games, a collection of links to related online resources in a social bookmarking tool (Delicious), photos and links to YouTube videos

on online gaming. Finally, the students were asked to place links in the text of their "project" to explanations of concepts they found in the wiki glossary of the course (i.e. if the term "Internet addiction" appeared in their text they had to link it to the wiki page that some other student had created to explain this concept). As presented in Figure 1, the student-produced content of their "projects" was used in the final oral exam of the course "Computer-Mediated Communication" and the students had to learn the theoretical content of up to three "projects" of their choice that were created by other students of this course.

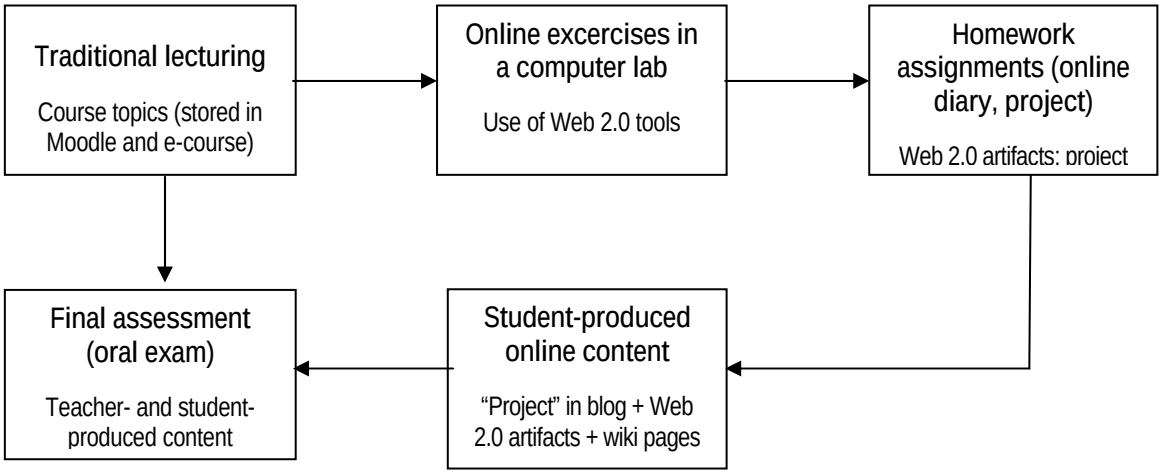

Figure 1. The procedure for the use of Web 2.0 tools in the course "Computer-Mediated Communication"

We tested the possibility to use Web 2.0 tools with two groups of full-time students of Information Systems study in the academic years 2008/2009 and 2009/2010 and found that they adopted the Web 2.0 tools and the online activities that they had to perform with them. However, some of the less computer-skilled part-time students had difficulty with using too many tools in one course. Online activities for such groups of students were therefore limited to several tools that were easy to learn. Our overall experience was that after a 10-15 minute demonstration of using a specific Web 2.0 tool almost all the students were able to use it effectively to perform an online learning activity. However, most online learning activities with Web 2.0 tools could not be successfully completed within a one-hour practice session in a computer laboratory and the students often had to finish their assignments at home.

In the academic year 2009/2010 the following new types of Web 2.0 tools were included in computer laboratory exercises for full-time students of the academic course "Computer-Mediated Communication": online notes taking (*Helipad, SpringNote*), mashups (*iGoogle*, *myYahoo, Pageflakes*), and user interface design (*MockFlow, Mockingbird*). The collaborative online notes taking tool *Notemesh* and the tool for creating learning objects *Nanolearning* were no longer used in the 2009/2010 academic year. The teachers were Goran Bubas and Ana Coric.

If the wiki (*MediaWiki*) and blog (*WordPress*) tool as well as *Google Docs* are counted, in the academic year 2009/2010 the students of the "Computer-Mediated Communication" course had an opportunity to learn about 18 different Web 2.0 tools during one semester (i.e. 15 weeks of teaching). Were the requirements for students too great and what are the possible positive outcomes of their effort? Our experience indicated that computer literate students of Information Systems were able to manage such tasks and that despite their slight initial resistance, by the end of the semester they had learned about diverse Web 2.0 tools and were satisfied with the skills that they developed.

According to literature, the use of Web 2.0 tools can help in the development of new literacies, support collaboration, and engage students through different modes of expression (Crook et al., 2008). Also, the educational use of various Web 2.0 tools can support diverse learning outcomes, increase student involvement and responsibility, create greater self-awareness, help them develop digital and social competencies, and facilitate the use of Web 2.0 content created by students as a

learning resource for other students (Grey at al., 2010). Web 2.0 technologies can be used to support shared knowledge-building, enhance student learning and improve their learning experience (Cooke, 2008). Accordingly, the greatest positive effects from the students' perspective that we noticed in two consecutive academic years of teaching the hybrid course "Computer-Mediated Communication" were related to their discovering of new online tools, development of novel Internet skills, greater potential for creativity and self-expression, and a different way of learning. Some of those effects are illustrated in the results of student evaluation survey in Figure 2 and Figure 3.

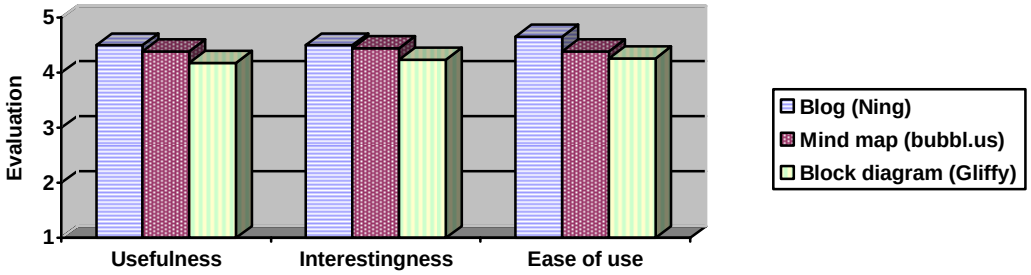

Figure 2. Results of student evaluation of a blog tool (a component of *Ning*), mindmap (bubbl.us), and block diagram tool (Gliffy) regarding usefulness, interestingness, and ease of use (scale: 1 = very poor, 5 = very good; N=38; part-time students)

To evaluate the effects of the use of Web 2.0 tools on education we performed a survey with questions about their usefulness, interestingness and usability, as well as those related to pedagogical effects like concept acquisition, expression of creativity, collaborative learning, positive impact on motivation and enrichment of educational experience. The results of student evaluation in Figure 2 indicate that we have made a good choice of the following Web 2.0 tools that were used in our courses: *Ning* social networking site (in fact the students evaluated a *blog tool* that was a component of *Ning*), a tool for online creation of mind maps (*bubbl.us*), and a tool for creation of block diagrams (*Gliffy*). All of these tools received an average rating above 4.0 on the scale ranging from 1 (very poor) to 5 (very good). The evaluators were two groups of part-time students of Business Informatics (total N=38) who attended a course "Computer-Mediated Communication". It can be concluded that the students found these tools useful, interesting and easy to use, with a potential for positive educational outcomes. In Figure 3 the results of evaluation of pedagogical effects of the use of Web 2.0 tools are presented. Again we found that the Web 2.0 tools were highly evaluated regarding (a) their potential to enable students to express their creativity, (b) positive influence of the use of those tools on increasing their motivation for learning, and (c) enrichment of students' educational experience. It must be noted that the students who had performed this evaluation were familiar with online learning since they were regular users of the Moodle LMS and that most of the courses they had attended were supported by at least some content in the Moodle system (e.g. course information, PowerPoint slides of lectures, etc.). Still, the novel experience with Web 2.0 tools may have positively influenced their evaluations.

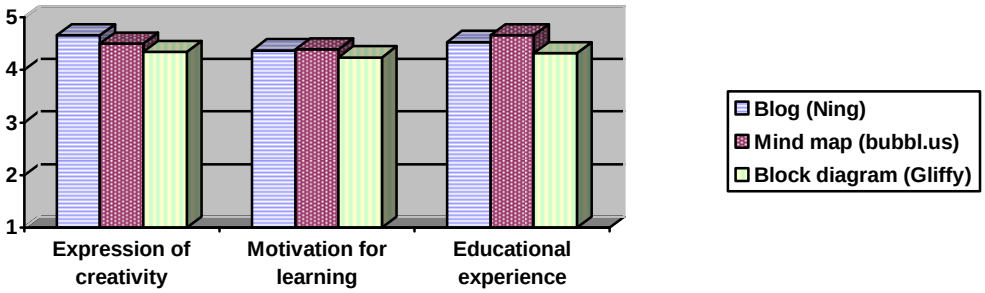

Figure 3. Results of student evaluation of a blog tool (a component of *Ning*), mind-maping (bubbl.us), and block-diagram tool (Gliffy) regarding their potential to express personal creativity, positive influence on motivation for learning, and enrichment of educational experience (scale: 1 = very poor, 5 = very good; N=38; part time students)

The evaluation of Web 2.0 tools that was performed during the 2008/2009 and 2009/2010 academic years with several study groups of students of the course "Computer-Mediated Communication" provides an example of the way such tools and pedagogical innovations could be implemented. Our conclusion is that Web 2.0 tools should first be tested on small groups of students in combination with concrete pedagogical activities which the students perform with such tools. It must be noted that we found some of those tools highly problematic regarding their reliability (*Nanolearning*) or that they were unattractive to students (*Notemesh*).

4.2. Usability study of Web 2.0 tools in the hybrid course "Data Structures"

The evaluation of Web 2.0 tools that was performed during the academic course "Data Structures" was more oriented toward a usability study. This usability study was performed by Tihomir Orehovacki with some guidance from Goran Bubas. During the course "Data Structures" in the winter semester of the academic year 2009/2010 students were given assignments which involved using diverse Web 2.0 tools to illustrate the content of the course and provide other students with instructions on how to better understand the course content. A detailed breakdown of the course content was presented to students in a wiki system. The students had to perform specific assignments that covered the most important topics of the course. For example, to complete an assignment related to the explanation of an algorithm that executes an operation of "walking" through a hierarchical tree data structure with a set of linked nodes a student with initials T.O. had to perform the following tasks: (1) use an online notes taking tool *Zoho Notebook* to present the theoretical content; (2) create a mind map with *Mind 42* that consisted of a visualized analysis of the problem; (3) depict the algorithm process with a block diagram tool *Mindomo*; (4) use a videopodcasting tool *Stupeflix* to present the program code of a solution with a synchronized audio recording of its narrative explanation; (5) post the programming solution in an online collaborative programming service *Bytemycode* for other students to view, analyze and comment; (6) place the artifacts created by Web 2.0 tools or links to their location on the web on their wiki page together with comments on the performed activities.

All the students who enrolled in the course had to perform four assignments during the semester and use different Web 2.0 tools for each assignment. In that way four Web 2.0 tools of each type were used and later evaluated by various subgroups of students. Finally, at the end of the semester the students responded to the items of a survey for usability evaluation of the following Web 2.0 tools:

- Online notes taking (iNetWord, Helipad, Google Docs, Zoho Notebook).
- Mind mapping (Mind 42, Mindomo, Mindmeister, Wise Mapping).
- Block diagrams (Draw Anywhere, Gliffy, Lucid Chart, Project Draw).
- Online presentations / video podcasting (Masher, Slidesix, Stupeflix, Yodio).
- Collaborative programming / SNS (Posteet, Github, Bytemycode, Pastebin).

The comprehensive survey that was designed by Tihomir Orehovacki for the evaluation of the usability of Web 2.0 tools consisted of items designed to measure the constructs like navigability, ease of use, understandability, reliability, error prevention etc. The idea of this study was to create a detailed usability survey for the evaluation of Web 2.0 tools that can be used in academic education and also to identify the Web 2.0 tools with highest usability in each of the previous categories, as well as potential usability problems of selected tools. However, in our study we also found that in the academic environment some categories of Web 2.0 tools manifested greater usability problems than others, as presented in Table 1. According to the evaluation that was performed by the students, the fewest usability problems were experienced with mind-mapping and block diagram tools, whereas the greatest amount of problems occurred while using video podcasting tools.

The newly created student survey for usability evaluation of Web 2.0 tools consisted of items that were, among others, related to the following attributes: *Navigability, Ease of Use, Mental/Physical effort, Understandability, Learnability, Usefulness, Efficiency, System quality, Customizability, Controllability, Availability, Accessibility, Reliability/Stability, Recoverability,* etc. (for a more detailed overview of potential usability attributes for evaluation of Web 2.0 tools see: Orehovacki, 2010). At the end of the winter semester of the academic year 2009/2010 the students gave their responses concerning the items of the survey to evaluate those Web 2.0 tools that they had used in the course "Data Structures". Therefore, the feedback about the usability of Web 2.0 tools was

provided by those who actually created the online content by using the evaluated tools (i.e. performed the assignments related to various course topics).

Table 1. Results of student evaluation of different categories of Web 2.0 tools (the percentages refer to the number of students whose evaluation indicated a potential problem with a specific tools; the numbers of students who performed the evaluation differed for each tool and the percentages are in fact average evaluations – for various groups N=158-171)

	Categories of Web 2.0 tools				
Usability attribute	**Online notes taking**	**Block diagrams**	**Mind maping**	**Video podcasting**	**Collaborative programming**
Navigability - User can quickly and easily locate all that is needed for performing a desired activity on a web tool.	20%	13%	7%	26%	19%
Ease of use – Only minimal effort is needed for performing of various activities with the web tool and control of the results.	19%	17%	8%	30%	15%
Understandability – User can immediately notice the operations (options) that are provided by the web tool.	17%	12%	5%	20%	17%
Reliability – There are no errors in the performance of the web tool (or they appear very rarely) and there are no interruptions while working with the web tool.	19%	15%	10%	28%	11%

The results of the evaluation of the worst performing video podcasting tool Masher in comparison to the best performing video podcasting tool SlideSix are presented in Figure 4. As many as 39.6% of the students who used Masher responded with "Disagree" or "Totally disagree" to the survey item *"Navigability - User can quickly and easily locate on a web tool all that is needed for performing a desired activity."* In comparison, only 16% of students who used SlideSix responded in the same way to that survey item, which indicates a considerably better performance of SlideSix regarding "Navigability" as a usability attribute.

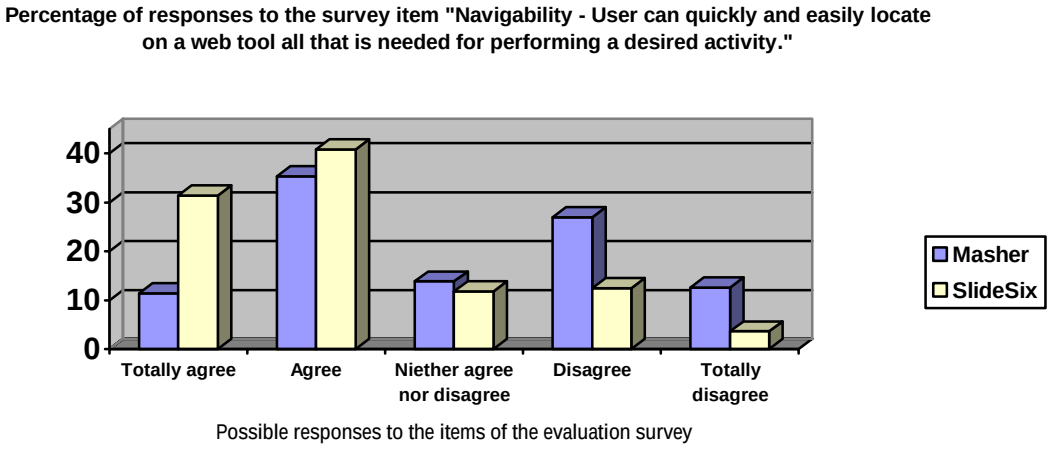

Figure 4. Results of student evaluation of video podcasting tools Masher (N=167) and SlideSix (N=169) regarding *navigability* as a usability attribute.

The other usability attribute that can be used for evaluation of Masher and SlideSix is *reliability*. In case of the video podcasting tool Masher as many as 37.2% of students responded with "Disagree" or "Totally disagree" to the survey item *"Reliability – There are no errors in the performance of the web tool (or they appear very rarely) and there are no interruptions while working with the web tool."* On the other hand, a much lower percentage of students (21,3%) responded the same way when they evaluated reliability as an attribute of SlideSix. The student responses that are presented in Figure 5 indicate that both tools manifest reliability problems, but that the SlideSix tool should be preferred for the educational purpose.

In our study we have tested four Web 2.0 video podcasting tools (Masher, SlideSix, Stupeflix, Yodio). According to the results of student evaluation of the selected usability attributes (Navigability, Ease of Use, Understandability, and Reliability), the *SlideSix* tool is probably the best choice. The Web 2.0 tools from other categories (online notes taking, block-diagrams, mind-maping) underwent the same kind of usability evaluation in concrete educational settings (i.e. with the use of an evaluation survey by the students who performed online activities/assignments). In the case of the mind-mapping tools (Mind 42, Mindomo, Mindmeister, Wise Mapping) we found that all of them received rather favorable evaluation. Among them, the *Mindomo* tool was the easiest to use and most understandable, and also received the highest average evaluation of efficiency and user satisfaction (with Mindmeister taking the second place). In the category of block-diagrams (Draw Anywhere, Gliffy, Lucid Chart, Project Draw), the Web 2.0 tool *Gliffy* received the highest, and the Project Draw tool the least favorable ratings regarding usability attributes. Finally, in the category of online notes-taking tools (iNetWord, Helipad, Google Docs, Zoho Notebook) the *Google Docs* tool considerably outperformed other tools regarding almost all the evaluated usability attributes.

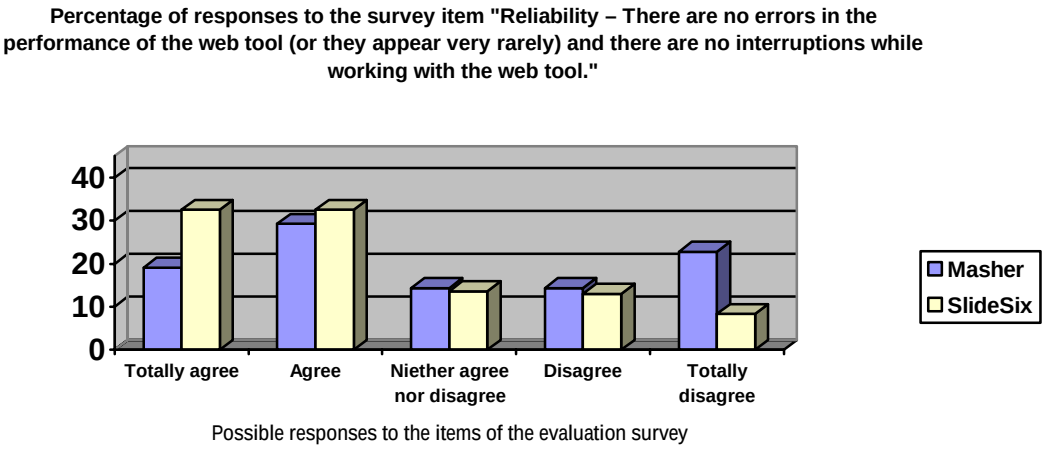

Figure 5. Results of student evaluation of video podcasting tools Masher (N=167) and SlideSix (N=169) regarding *reliability* as a usability attribute.

As a conclusion to the usability evaluations that we have performed with the help of the students in the course "Data Structures" the following quotation from Niall Sclater (2008) seems appropriate: "Offering products with widely differing user interfaces that have not been checked for accessibility and usability may be inadvisable". As a result of this study we can recommend the following tools for use in the academic educational environment: Mindomo (mind-mapping), Gliffy (block-diagram/flowchart), Google Docs (online notes taking), and SlideSix (video podcasting). Also, the authors of the presented usability study are not familiar with any similar use of Web 2.0 tools in a course related to computer programming and the pedagogical aspects of using such tools to illustrate and explain the important topics of the course and facilitate peer-to-peer learning are perhaps another significant contribution.

4.3. Visualization of grammar in collaborative second language learning

As an addition to the *Engwiki* project, in the winter semester of the 2009/2010 academic year we developed a concept of collaborative language learning with online activities related to the

visualization of the English grammar with the use of various Web 2.0 tools. Specifically, for mind-mapping we used *Mindmeister* and *bubbl.us*, whereas for block-diagrams *Gliffy* was used; for video podcasting and video tagging the *SlideSix* and *Veotag* tools were chosen, while *Bubblr* was used for online comic strip creation from Flickr photos. In the previous stages of the Engwiki project that was led by Andreja Kovacic (see Kovacic et al., 2008) only a wiki was used to develop, implement and evaluate various online learning activities. In this further stage of development of the use of Web 2.0 tools for teaching English as a foreign language (EFL) conducted by Andreja Kovacic (with the assistance of Ana Coric and Goran Bubas) the students were required to use Web 2.0 tools to create collaborative learning material for other students concerning various course related topics. They were primarily grammar-oriented and included acronyms vs. abbreviations, prefixes and suffixes, making plural, countable vs. uncountable nouns, the English tense system, noun phrases and multiple compounds, when to use the passive, etc. In the case of the *acronyms vs. abbreviations* topic two pairs of students who worked on this assignment used the mind-mapping tools *bubbl.us* and *Mindomo* to accompany the theoretical content of this part of the English grammar by providing its visual structure and examples; one student used a block diagram tool *Gliffy* to present an "algorithm" on how to decide whether a lexical item is an acronym or an abbreviation; two students used an online cartoon strip tool Bubblr to create a funny illustration of a situation in class about learning acronyms/abbreviations; finally, two students used a video tagging tool Veotag to annotate a video recording of a speech about the use of robots in future warfare, i.e. create "tags" or "jumps" (links) to the parts of the speech where acronyms and abbreviations are mentioned. The example of a mind-map on the difference between acronyms and abbreviations is presented in Figure 6 and the "algorithm" for deciding whether a lexical item is an acronym or an abbreviation is depicted in Figure 7.

The visualization of the English grammar in online collaborative second language learning will continue in the academic year 2010/2011 and is perhaps the first use of Web 2.0 tools for such a purpose. The explanation of the use of Web 2.0 tools for grammar related online activities is available on the Engwiki website (http://e.foi.hr/engwiki/index.php/Grammar_Web_2.0), as well as the list of the grammar topics to be covered in students' assignments in 2009 and 2010, with a selection of completed students' articles (http://e.foi.hr/engwiki/index.php/Grammar_e-tivities).

4.4. Integration of students' assignments in wiki, blog, online social community tool Ning, e-portfolio, and Moodle LMS

One of the potential problems of using Web 2.0 tools for students' assignments is the integration of the work that they produce in a single virtual space so that it can be used for collaborative learning by other students. Perhaps the easiest way to solve this problem is to use a *wiki* in which the teacher places organizational pages (with the description of online activities, topics of assignments that the students can volunteer to perform, links to Web 2.0 tools etc.). Similarly, a wiki can be used by the students to create articles in form of wiki pages with theoretical text, photographs and other illustrations, links to YouTube video, as well as the content that they produce with Web 2.0 tools (mind-maps, block-diagrams, video podcasts, online cartoon strips, etc.). Furthermore, a wiki is a good choice for creating online glossaries and large structured projects. We have used the wiki (MediaWiki) to present students' work with Web 2.0 tools in the courses "Data Structures" and "English Language I".

In the course "Computer-Mediated Communication" in the academic years 2008/2009 and 2009/2010 we successfully used a *blog tool* (WorldPress) in which students documented their learning of various Web 2.0 tools in form of a diary of their weekly course related activities. Students also integrated the final results of their use of various Web 2.0 tools on their blogs in form of a "project" on a specific topic (e.g. online communication skills, internet addiction, online gaming, etc.) that consisted of a theoretical text description, photos and YouTube videos. This project presentation included links to artifacts created with Web 2.0 tools like mind-maps, block-diagrams, online surveys, online comic strips, tagged video or slides with narration etc. The use of the blog tool provided more possibility and motivation for creative expression of students. Finally, at the end of semester best students' projects were placed in the Moodle system alongside with the theoretical content provided by the teachers of the course.

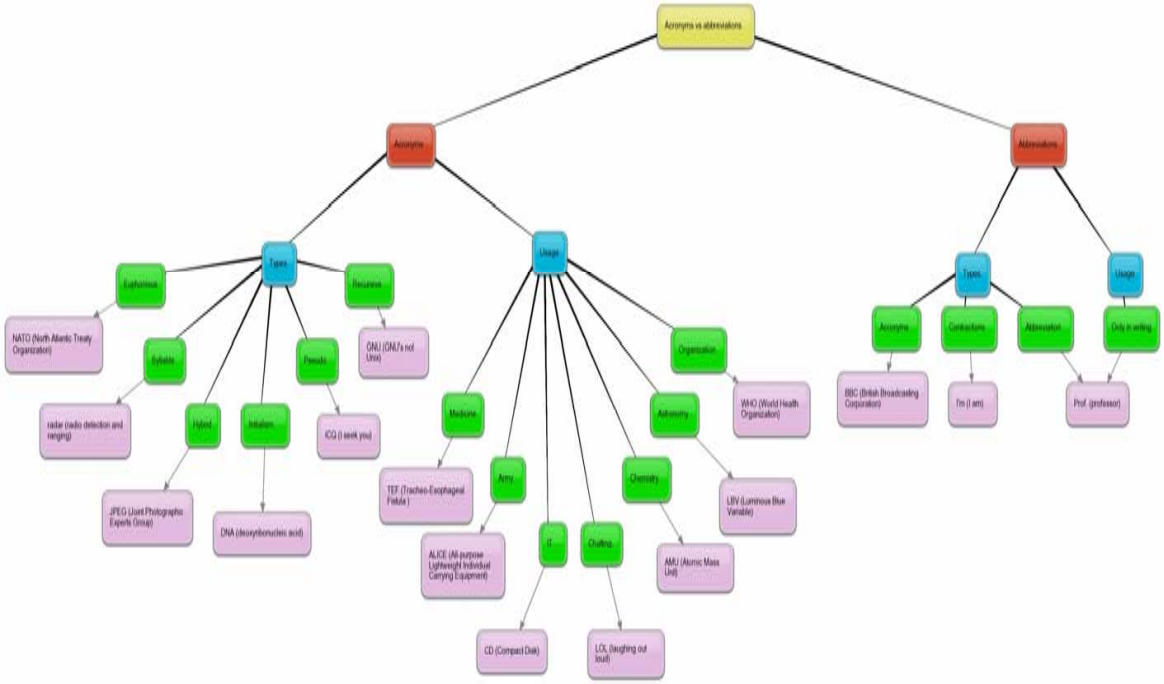

Figure 6. Example of the use of a Web 2.0 tool *bubbl.us* to create a mind-map which visualizes the difference between acronyms and abbreviations in the English language (created by students Igor R. and Nikola P.)

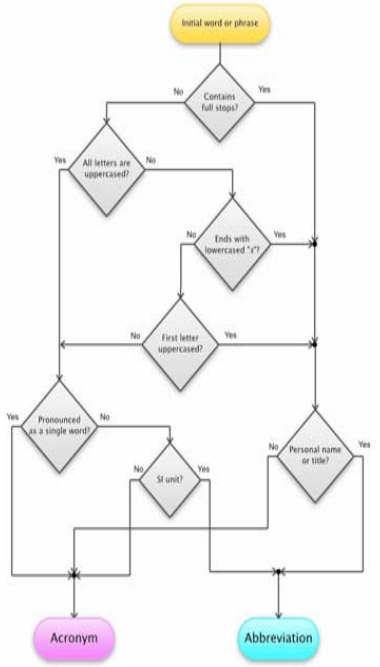

Figure 7. An example of the use of a Web 2.0 tool *Gliffy* to create a block-diagram which depicts the "algorithm" for deciding whether a lexical item is an acronym or abbreviation (created by student Josip L.)

For two groups of part-time students of the course "Computer-Mediated Communication" in the summer semester of 2009/2010 academic year we used an online community tool *Ning* instead of a wiki or a blog. The Ning tool is a platform that supports personal profile pages, forum, chat, events management, a blog tool, upload and sharing of images and video files, etc. We asked the students of both study groups to use Ning to keep a blog (online diary) of their course related activities and to place in their blog the Web 2.0 artifacts that they had created (or the links to those artifacts). It must be noted that the Ning tool received very favorable ratings by both groups of students as well as the blog tool in Ning. One of the students' verbal comments on the use of Ning was that it is an excellent tool for members of small study groups to get to know each other, collaborate and support each other in course assignments. We recommend Ning or a similar tool for study groups of 15-40 students. It must be noted that most of our official course related learning content was in Moodle LMS and that Ning was used for communication and collaboration activities, as well as for sharing of the learning content discovered or created by the students themselves.

For a very large group of 190 students of the course "Social Aspects of Computer-Mediated Communication" we decided to use a *wiki tool* in a Moodle LMS. In one assignment the students of that course chose and reserved assignment topics by using the wiki tool and also created wiki articles (separate wiki pages) displaying the results of their assignments in form of essays or professional papers. In another home assignment teams of students chose from among Web 2.0 tools listed in 45 categories and created wiki pages with their descriptions of more than 65 tools that they found interesting for themselves and their colleagues. Although the wiki tool in Moodle had a greater potential for visual presentation since it used a WYSIWYG editor and its content is not open to public viewing, the MediaWiki somehow appeared to be more appealing to the students (and their teacher).

It is our conclusion that the use of more than one Web 2.0 tool in a hybrid university course needs an integration tool like wiki, blog, Ning, e-portfolio, or Moodle. We recommend an experimental use of such integration tools until the teacher(s) find what is optimal for a specific group of students (small/large, full-time or part-time, more or less computer literate, etc.) and the course topic.

5. CONCLUSION

The *EduWeb2.0* project that was funded by the Ministry of Science, Education and Sports of the Republic of Croatia, had the following main goals:

(1) Select and evaluate 20 different Web 2.0 tools in the academic environment by using those tools in hybrid university courses and performing usability evaluation.
(2) Present the results of the evaluation of Web 2.0 tools on the project web site as well as case studies of their use in academic courses.
(3) Perform workshops and presentations for the promotion of the use of Web 2.0 tools in teaching at the academic level.

Because of a considerable setback (partly caused by the fact that 35+ tools were evaluated instead of 20 and because it was decided that the project website would be in English instead of Croatian) all of project web pages were not finished in June 2010 as planned. The project wiki is placed on the web site http://e.foi.hr/iProjekt/index.php/Main_Page

The **technology part** of the *EduWeb2.0* project included the application of the following types of Web 2.0 tools in several university courses by the end of the summer semester of the 2009/2010 academic year and the testing of usability of many of those tools with an extensive survey:

- Online notes taking (iNetWord, Helipad, Google Docs, Springnote, Zoho Notebook).
- Mind-mapping (bubbl.us, Mind 42, Mindomo, Minmeister, Wise Mapping).
- Block-diagrams (Draw Anywhere, Gliffy, Lucid Chart, Project Draw).
- Online presentations / video podcasting (Masher, Slidesix, Slidestory, Stupeflix, Veotag, Yodio).
- Audio podcasting (Podomatic, Woices).
- Collaborative programming / SNS (Posteet, Github, Bytemycode, Pastebin).
- Online comic strip creation (Bubblr).
- Mashups (iGoogle, My Yahoo!, Pageflakes)
- Mockups / user-interface design (MockFlow, Mockingbird).
- Social bookmarking (Delicious).
- Online surveys (JotForm).

- Social networking (Ning, SocialGO), etc.

The **pedagogy part** of the *EduWeb2.0* project included the previously mentioned Web 2.0 tools and some other social networking tools that were implemented in hybrid courses and tested regarding their usefulness for the design of online learning activities in hybrid university courses: wiki (MediaWiki), blog (WordPress), e-portfolio (Mahara). In the 2009/2010 academic year more than 35 Web 2.0 tools were tested on different groups of students of the following university courses: "Computer-Mediated Communication", "Data Structures" and "English Language 1". The intention of the teachers was to use with each group of students several tools that complement each other regarding the pedagogical goals and content of a course in order to facilitate knowledge production and collaborative (peer-to-peer) learning. Once the Web 2.0 tools were tested in concrete courses their usefulness (benefits for learning) was evaluated by the students who implemented them in various learning activities. It was also planned that the teachers present their experiences with the Web 2.0 tools and provide scenarios for their application. Finally, together with the presentation of each of the specific Web 2.0 tools, their brief case study and the results of usability analysis, the potentially applicable online pedagogical activities (e-tivities) would be suggested on the *EduWeb2.0* project wiki pages.

The **innovation aspects** of the *EduWeb2.*0 project include the implementation of several complementary Web 2.0 tools to design and enhance the learning experiences of students and develop their skills in using novel web-based open source (free) technology and services. We found that standard Web 2.0 tools like wiki and blog can be combined with social bookmarking, mind-maps, block-diagrams, comic strip creation, online presentations with audio recordings, online surveys, mashups, etc. Also, the creation of attractive online content in wikies and blogs for peer-to-peer learning by individuals and student teams was greatly supported by the use of more than one Web 2.0 tool. Furthermore, our recommendations to other teachers will include the results of our usability tests so that they can avoid using the Web 2.0 tools which may cause them technical problems in implementation of online learning activities and scenarios.

Usefulness and benefits of the innovation of the *EduWeb2.0* project are related to the combination of case studies of the use of numerous Web 2.0 tools in concrete university courses, usability evaluation, and suggested e-learning activities for specific Web 2.0 tools. The project aims to resolve some of the disadvantages and adoption problems associated with the use of Web 2.0 tools in e-learning that were mentioned in the introduction of this paper. A series of workshops for academic teachers is planed in 2010. It must be noted that a usability procedure for the evaluation of Web 2.0 tools in educational settings is being developed that will include not only surveys but also expert evaluations and task-related procedures for more reliable Web 2.0 tools. The project will briefly address some privacy and security issues regarding the use of Web 2.0 tools and related technology (both on the client and server side), as well as accessibility of Web 2.0 tools. Finally, a wiki-based *EduWeb2.0* project website in English (and Croatian) language, together with presentations at international e-learning conferences, will help disseminate the results of our project.

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