

BULETINUL INSTITUTULUI POLITEHNIC DIN IAȘI  
Publicat de  
Universitatea Tehnică „Gheorghe Asachi” din Iași  
Tomul LVI (LX), Fasc. 4, 2010  
Secția  
AUTOMATICĂ și CALCULATOARE

## FROM WELSA 1.0 TO WELSA 2.0: ACCOMMODATING SOCIAL LEARNING FEATURES<sup>1</sup>

BY

ELVIRA POPESCU

**Abstract.** WELSA 1.0 was conceived as an intelligent adaptive educational system, which provides individualized courses, according to students' learning styles. What the initial version of WELSA is missing is the social dimension of learning (*i.e.*, students' opportunity to interact, communicate and collaborate with their peers, actively creating and sharing knowledge). In this paper, we aim to add several social learning features to WELSA, by integrating a set of Web 2.0 tools into the platform. Our approach is motivated by the recent advent of social software tools in education (*e.g.*, blog, wiki, social bookmarking systems, media sharing tools etc.), with encouraging results.

The paper opens with a discussion of the implications of Web 2.0 for education, including a successful case study. Next, WELSA 1.0 is briefly presented. Finally, a mashup-based solution is described for the integration of the Web 2.0 tools; the necessary extensions for each system component are also introduced, leading towards WELSA 2.0.

**Key words:** adaptive educational system, learning style, Web 2.0, social software, social learning environment.

*2000 Mathematics Subject Classification:* 97U50, 68T05.

### 1. Introduction

In the world of pervasive Internet, learners are also evolving: the so-called “*digital natives*” (persons born and raised after the development of digital technologies) [23] want to be in constant communication with their peers, they expect an individualized instruction and a personalized learning environment, which automatically adapts to their learning preferences.

---

<sup>1</sup> This is an extended version of the paper: Popescu E., *Adding a Social Dimension to a Learning Style-based Adaptive Educational System*. Proc. ICSTC 2010, 391–396, 2010.

Therefore the need to offer intelligent e-learning platforms, where students can learn in a personalized way, by interacting and collaborating with their teachers and peers.

A first step towards attaining this goal was the creation of WELSA platform (**Web-based Educational system with Learning Style Adaptation**) [17]. WELSA is aimed at providing courses adapted to each student's learning style, one of the individual characteristics that play an important role in the learning process, according to educational psychologists [18]. More specifically, learning style represents the individual manner in which a person approaches a learning task, the learning strategies activated in order to fulfill that task. For example, some learners prefer graphical representations and remember best what they see, others prefer audio materials and remember best what they hear, while others prefer text and remember best what they read. There are students who like to be presented first with the definitions followed by examples, while others prefer abstract concepts to be first illustrated by a concrete, practical example. Similarly, some students learn easier when confronted with hands-on experiences, while others prefer traditional lectures and need time to think things through. Some students prefer to work in groups, others learn better alone. These are just a few examples of the many different preferences related to perception modality, processing and organizing information, reasoning, social aspects etc., all of which can be included in the learning style concept [16].

In the last few years, Web 2.0 tools (also known as “social software tools”, e.g., *blog*, *wiki*, *social bookmarking systems*, *media sharing tools*) gained a lot of attention and started to be used in educational settings [10], [11], with encouraging results with respect to student satisfaction, knowledge gain and/or learning efficiency. This is motivated by the fact that the principles Web 2.0 is based on (user-centered, participative architecture, openness, interaction, social networks, collaboration) are in line with modern educational theories such as socio-constructivism [25]. According to it, knowledge cannot be transmitted but has to be constructed by the individual, by means of collaborative efforts of groups of learners [24]. In this context, it is only natural to try to merge the advantages of personalization already provided by WELSA with those promised by Web 2.0 tools. We therefore decided to add a social dimension to WELSA, by integrating a set of Web 2.0 tools with demonstrated pedagogical value into the platform. From a technical point of view, the solution that we propose is based on mashups [13], ensuring a lightweight architecture, with loosely-coupled components.

More details regarding the application of Web 2.0 in education are included in the following section. Next, in section 3, we present an overview of the initial version of WELSA (WELSA 1.0); the extensions that we propose are described in section 4 (WELSA 2.0). Finally, in section 5, we draw some conclusions and point toward future research directions.

## 2. Web 2.0 in Education

*Web 2.0* is a term promoted by Tim O'Reilly [12], which designates a set of interactive and collaborative aspects of the Web seen as a platform (*i.e.*, the applications are built on and for the Web, not for desktop). Although the term suggests a new version of World Wide Web, it actually refers to a change not in technical specifications, but in the way the Web is used by programmers and simple users. Web 2.0 brings a user-centered approach – designing applications whose content is generated by the users and therefore depend heavily on their contribution (*e.g.*, YouTube, Flickr, Delicious). Consequently, Web 2.0 is also known as “participative Web”: the user is not just content consumer but also content generator (often in a collaborative manner). Furthermore, Web 2.0 is also called “social Web”: with the advent of social networks, it started offering support for users to interact, communicate and collaborate (*e.g.*, Facebook, MySpace, Twitter).

Recently, Web 2.0 tools have been introduced in educational contexts. Thus, the term *e-learning 2.0* emerged, being coined by Stephen Downes [7]; it refers to the impact that Web 2.0 has on education, modeling learning communities as social networks. From a more technological viewpoint, Anderson's report [2] outlines 6 “big ideas behind Web 2.0” and explores their implications for education: i) individual production and user generated content; ii) harnessing the power of the crowd; iii) data on an epic scale; iv) architecture of participation; v) network effects, power laws and the long tail; vi) openness. According to [30], technological progress and the rise of social networking will have a significant impact on the way people learn in the future.

Paper [10] presents practical guidelines for the use of Web 2.0 technologies to support teaching and learning, illustrating them with actual pedagogical scenarios. Blogs, for example, can be seen as a means for students to publish their own ideas, essays and homework and as a space where they can reflect on their learning process (*i.e.*, a kind of “learning diary”). Furthermore, posting comments to blog articles represents a means of social interaction, as well as an opportunity to provide critical and constructive feedback. Also, blogs help create a sense of community among students with similar interests (“educational blogosphere”). Similarly, wikis can be used as a means of collaborative creation of knowledge artifacts, Wikipedia being a prominent example. In educational settings, wikis can be successfully used for collaborative writing tasks among the members of a team, as well as for creating and maintaining learning content, both by students and teachers. Social bookmarking tools can be used for storing and sharing links to resources of interest for the course (*i.e.*, a kind of “personal knowledge management tool”). Students can share bookmarks they have discovered with their peers and also tag and rate the collected resources. A comprehensive review of papers

reporting actual applications of Web 2.0 technologies and tools in formal learning settings can be found in [11].

An example of such an application in the context of our own institution (University of Craiova, Romania) is reported in [20]. More specifically, we decided to use blog and wiki as support tools for the project activity associated to the “Web Applications' Design” course. 30 undergraduate students in Computer Science were actively involved in the project, being split in 6 teams. The project activity was done in a blended mode, with weekly face-to-face meetings in which students could directly interact with the instructor, asking for help and clarifications, doing hands-on exercises, discussing contributions, checking the assignment progress, and presenting the final project results. Furthermore, students were asked to use a blog for communicating with their peers, documenting the progress of the project (reporting each accomplished activity, describing problems encountered and asking for help, providing solutions for peers' problems, sharing their experience with a technology/tool, etc.) and reflecting on their learning experience. They were also instructed to use a wiki for gathering and organizing their knowledge and resources regarding the project theme; the wiki would also represent a space for collaboratively writing the project documentation. Both the blog and the wiki were team-oriented (*i.e.*, each team had their own blog and their own namespace on the wiki).

Fig. 1 includes a snapshot from a blog post pertaining to Team 4, in which a student describes the process of improving and extending a previously implemented component. Fig. 2 includes a snapshot from the project documentation, as written collaboratively on the wiki by Team 2.

According to students' answers to the opinion questionnaires applied at the end of the course, both the blog and the wiki were easy to learn and use, with virtually no technical problems encountered. Furthermore, both tools were found very useful by the students, facilitating communication and collaboration between team members, increasing interest, motivation and involvement, helping to organize knowledge, supporting experience exchange and feedback from peers. A few drawbacks were also pointed out: i) team work may sometimes be disadvantaging for students if they have to rely on the work of their peers who refuse to cooperate; ii) a high amount of time was needed to complete the assignment (however, this can be explained by the fact that this experiment was a premiere for the students, so they needed some time to get accustomed with the required tasks and the new collaborative work approach); iii) exposing one's work, ideas and thoughts to the others may be frustrating for some (although usually it has the contrary effect: increased motivation and competitiveness).

Finally, the high majority of the students showed willingness and enthusiasm towards the large-scale introduction of Web 2.0 tools in the instructional process [20]. These encouraging results further motivate our endeavor of extending WELSA adaptive educational system with social features.

**Web Applications Design Team 4**  
SOFTWARE ENGINEERING DEPARTMENT'S WEB APPLICATION DESIGN TEAM 4

Search this Blog

home about

« An example of how we can integrate a JAVA Intalling and configuring Java, PHP and class in a PHP project PECL extension »

**9 DEC** **Sistemul de rating, up and running**  
Posted December 9, 2009 by Tommy in WAD **2 Comments**

Saptamana trecuta am realizat o implementare nu tocmai completa a sistemului de rating, inasa reprezenta o forma functionala a acestuia. Azi m-am decis sa finalizez ceea ce mi-am propus si, de ce nu, sa adaug cateva functionalitati suplimentare.

Zis si facut. Mai intai am trecut in revista ce aveam de facut:

- ratingul nu se poate face decat daca userul este logat
- cand se da un rating unui bookmark daca userul a mai dat rating acelui bookmark atunci se face UPDATE in tabela MySQL, in caz contrar se face INSERT
- asisarea in timp real a ratingului pentru fiecare bookmark

Implementarea nu a fost prea complicata, inasa micile erori de sintaxa si-au facut simtita prezenta si au prelungit rezultatul final. De mentionat ca platforma scutite are o constructie oarecum bizara si de cele mai multe ori e mai simplu sa-ti creezi propriile extensii decat sa folosesti ceea ce este deja implementat. Oricum acest lucru conteaza mai putin, important fiind rezultatul.

De indata ce am finalizat implementarea punctelor de mai sus, am trecut la implementarea unor aspecte dintre care unele tin mai mult de interactiunea userului cu mediul de rating.

1. extinderea numarului de stelute pentru rating de la 5 la 10 cu pastrarea functionalitatii
2. activarea tuturor steluțelor pana la steluta deasupra careia se afla mouse-ul
3. plasarea deasupra steluței curente pe care se afla mouse-ul a notei corespunzatoare steluței
4. optimizarea codului pentru browserele: Opera, Mozilla Firefox, Internet Explorer,

**Options**

- Site Admin
- Log out
- Entries RSS
- Comments RSS
- WordPress.com

**Recent Posts**

- Questions and answers
- Questions and answers
- Questions and answers
- Questions and answers
- Recommended systems

**Blogroll**

- Team 1
- Team 2
- Team 3
- Team 4
- Team 5
- Team 6

Fig. 1 – Snapshot from a team's blog.

**team2:documentation**

Edit this page | Old revisions | Recent changes | Search

Trace: » start » team2 » documentation

**Documentation**

**Chapter 1: Introduction** [Edit]

Our on-line students, being mainly busy worker students, study almost alone. To improve their interaction we use asynchronous tools (Wiki or forums), but we notice that interaction becomes high mainly when the discussion is focused on a task to be graded for the exam or when the teacher/tutor is very active in the community. We present X-Tasy, our exercise sharing tool, an application to e-learning of a simple reputation system to increase the student motivation and interaction, and to let them learning from each other, either by reusing other's solutions or by correcting other's mistakes. Moreover, students gain reputation from others reusing their solutions. In this we want to engage students in learning activities at the highest cognitive levels of the Bloom taxonomy. We present an application to e-learning of basic reputation system techniques, developed with the aims of increasing the motivation and level of interaction among students, and helping the students to learn from each other, such that each one can reuse (at different levels) a solution proposed by another, and possibly spot some mistakes found there. We have implemented X-Tasy, an exercise sharing tool where students gain reputation in front of the teacher and (especially) of the other students by submitting solutions to exercises and by collecting endorsements by other students inspired to reused solutions. Our main goals are:

- to increase the motivation in doing exercises and activities
- to increase the collaboration and sharing
- to increase critical thinking (while analyzing other's solutions and looking for errors)

And thus engage students in Learning Objectives at the highest conceptual levels of the Bloom taxonomy.

**Chapter 2: Theoretical aspects regarding the technologies, frameworks and algorithms used** [Edit]

**2.1. Introduction**

The main technology that we used in our project is JavaServer Pages, or in abbreviation JSP. The sequences of code are written in Java combined with HTML.

We can not say that we used specific algorithms, because we mainly used databases operations.

**2.2. A short description of JSP**

JavaServer Pages (JSP) is a server side Java technology that allows software developers to create dynamically generated web pages, with HTML, XML, or other document types, in response to a Web client request to a Java Web Application container (server). Architecturally, JSP may be viewed as a high-level abstraction of Java servlets. JSP pages are loaded in the server and operated from a structured special installed Java server packet called a J2EE Web Application often packaged as a .war or .ear file

**Table of Contents**

- Documentation
- Chapter 1: Introduction
- Chapter 2: Theoretical aspects regarding the technologies, frameworks and algorithms used
- Chapter 3: General structured architecture of the application
- Chapter 4: Implementation details
- Chapter 5: User manual
- Chapter 6: Conclusions and future work
- Chapter 7: References
- Usability of e-learning websites
- How to test a web application
- Database Update

Fig. 2 – Snapshot from a team's wiki.

### 3. WELSA 1.0

WELSA is an intelligent learning environment, which dynamically adapts the courses to the learning style of each student. The process implies two stages:

1. identifying the learning style of the student (modeling stage);
2. applying the corresponding adaptation rules (adaptation stage).

Please note that a detailed presentation of WELSA 1.0 can be found in [17]. In what follows, we give a brief overview of the system, outlining its main functionalities and underlying principles.

#### 3.1. Learner Modeling

An important step towards an accurate learner diagnosis is the selection of an appropriate taxonomy of learning styles. Based on an extensive examination of the learning style models proposed in the literature, we created our own model, called ULSM (Unified Learning Style Model), which integrates the most representative characteristics from traditional models. Thus, ULSM includes preferences related to: perceptual modality, way of processing and organizing information, motivational and social aspects (*e.g.*, *Visual/Verbal*, *Abstract/Concrete*, *Serial/Holistic*, *Active experimentation/Reflective observation*, *Individual work/Team work*, *Intrinsic motivation/Extrinsic motivation*). A detailed description of the ULSM model, as well as its advantages over traditional models in e-learning settings is included in [18].

Based on our own experimental studies [15], as well as other similar reports [9], we consider students' behavior in the system (*i.e.*, time spent on each type of learning resources, order of accessing the resources, level of involvement with the communication tools) to be an accurate indicator of their learning preferences. We therefore decided to use an implicit modeling method, based on the automatic monitoring and analysis of students' actions in the system (as opposed to an explicit modeling method, based on students' answers to dedicated psychological questionnaires).

The modeling process unfolds as follows: first, the logged student actions are preprocessed and aggregated to yield the behavioral patterns. Next, the reliability levels of these patterns are calculated as well (*i.e.*, the larger the number of available relevant actions, the more reliable the resulted pattern). Subsequently, the WELSA Analysis tool computes the ULSM preference values, using modeling rules based on the pattern values, their reliability levels and their weights. It should be noted that these rules also take into account the specificities of each course: the pattern thresholds as well as the importance of each pattern may vary with the structure and subject of the course. Therefore, the teachers should have the possibility to adjust the predefined values to correspond to the particularities of her/his course or even to eliminate some of the patterns, which are not relevant for that course. This is why the WELSA

Analysis tool has a configuration option, which allows the teacher to modify the weight and threshold values.

### 3.2. Adaptation Provisioning

Once the students' learning preferences are identified by the WELSA Analysis tool, the next step is to associate adaptation actions that are best suited for each preference. More specifically, we decided to use adaptive sorting and adaptive annotation techniques. Thus, the learning objects (LOs) are placed in the course page in the order which is most appropriate for each learner; additionally, a “traffic light” technique was used to differentiate between recommended LOs (with a highlighted green title), standard LOs (with a black title) and not recommended LOs (with a dimmed light grey title). It should be mentioned however that the learning path suggested by the system is not compulsory: it is simply a recommendation that the student may choose to follow or not. We consider that offering control to students, instead of strictly guiding them, is a more flexible and rewarding pedagogic approach [17].

From a technical point of view, it should be mentioned that WELSA does not store the individualized course web pages, but instead generates them on the fly, each time an HTTP request is received by the server. The adaptation component queries the learner model database, in order to find the ULSM preferences of the current student. Based on these preferences, the component applies the corresponding adaptation rules and generates the new HTML page, by automatically composing it from the selected and ordered LOs, each with its own status (highlighted, dimmed or standard).

Fig. 3 gives an overall view of WELSA system, illustrating the interactions with the two main actors (the student and the teacher), as well as the process workflow. As can be seen in the figure, WELSA is composed of three main modules:

- an authoring tool for the teachers, allowing them to create courses conforming to the internal WELSA format (XML-based representation);
- a data analysis tool, which is responsible for: i) interpreting the behavior of the students and consequently building and updating the learner model, based on the built-in modeling rules; ii) providing configuration options for the teachers, who can set certain parameters of the modeling process, so that it fits the particularities of their own course; iii) providing various aggregated information about the learners;
- a course player (basic learning management system) for the students, enhanced with two special capabilities: i) learner tracking functionality (monitoring the student interaction with the system); ii) adaptation functionality (incorporating adaptation logic and offering individualized course pages).

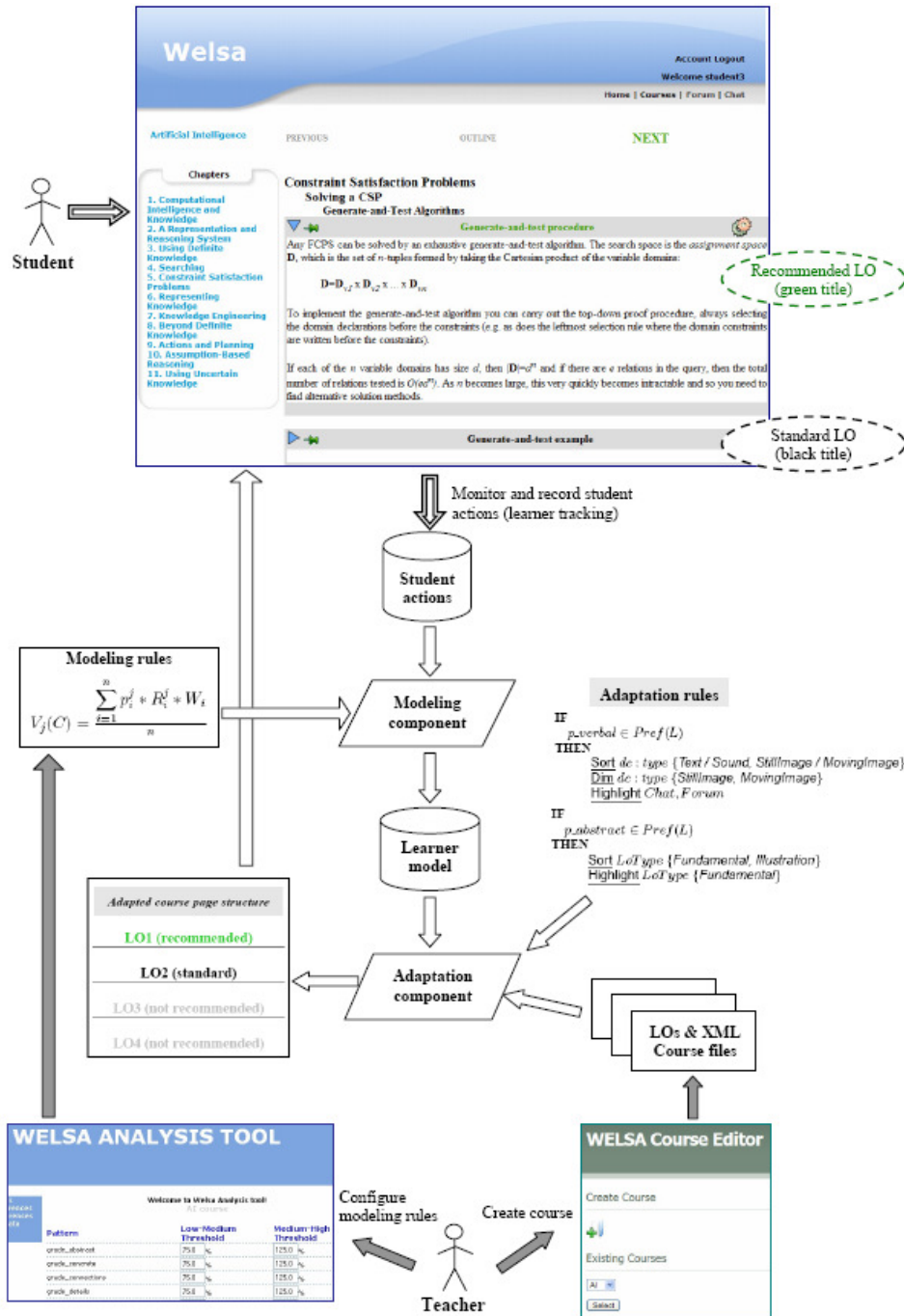


Fig. 3 – WELSA 1.0 overall architecture.

As far as the implementation is concerned, Java-based and XML technologies are employed for all WELSA components. Apache Tomcat 6.0 is used as HTTP web server and servlet container and MySQL 5.0 is used as DBMS.

### 3.3. System Validation

According to the layered evaluation approach proposed in [4], WELSA was validated experimentally both from the learner modeling and the adaptation provisioning point of view. The results of the former experiment are presented in [16], while the results of the latter are reported in [19].

Furthermore, we performed also a global evaluation of the WELSA system. After following the course sessions, the 71 students participating in the experiment were asked to assess various aspects of their learning experience with WELSA, on a 1 to 10 scale (*e.g.*, course content, presentation, platform interface, navigation options, communication and collaboration tools, the course as a whole). Very good marks were assigned to most of the features, with only one feature (the communication tools) receiving lower ratings; this can be explained by the fact that only basic communication functionalities were offered to the students (*i.e.*, forum and chat). All in all, we can conclude that students had a very positive learning experience with WELSA. These findings are also reflected in the readiness of the students to adopt WELSA system for large scale use, with 87.50% of them willing to do so and only 6.25% reluctant [17].

Based on the results of the experiment (*i.e.*, students' suggestions regarding the use of more advanced communication and collaboration tools), as well as on the increasing importance of Web 2.0 applications in education (as pointed out in section 2), we decided to add a social dimension to our system, leading towards *WELSA 2.0*. More specifically, we decided to extend the communication and collaboration functionalities with the new generation of Web 2.0 tools (blog, social bookmarking tool, microblogging tool etc.). The next section gives an overview of the platform extensions performed to this end.

## 4. Towards WELSA 2.0

### 4.1. Architectural Issues

The integration of the Web 2.0 components can be done by means of *mashups* (*i.e.*, combining data and/or functionalities from two or more external sources to create a new Web application). Accessing data and functionalities can be done by several methods:

- APIs (Application Programming Interface) based on REST (Representational State Transfer);
- RSS (Really Simple Syndication) feed integration;
- Screen scraping [13].

Paper [3] presents a review of mashup applications in various domains; examples of e-learning applications include: [8], [26].

The first step towards the creation of WELSA 2.0 was to select the most suitable Web 2.0 tools to be integrated in the system, which meet two requirements:

- have a demonstrated pedagogical value (according to case studies reported in the literature);
- offer technical support for integration (well documented and maintained APIs, RSS feeds etc.).

We therefore decided to add the following tools in WELSA: blog (Blogger [27]), social bookmarking tool (Delicious [29]), microblogging tool (Twitter [31]). Naturally, the range of social media instruments could be subsequently extended.

Thus, students will be able to use these tools (that most of them are already familiar with in informal contexts outside school) in a semi-formal framework, in the WELSA e-learning platform. The tools are added as widgets in the platform interface (*i.e.*, *aggregation mashups*); all student actions (such as: *post\_blog\_message*, *add\_bookmark*, *post\_tweet* etc.) can be retrieved from the tools (by means of APIs or RSS) and recorded in the platform's database, for further processing (*i.e.*, *integration mashups*).

Fig. 4 shows a schematic architecture of WELSA 2.0, highlighting the newly added or extended components (grey shaded areas):

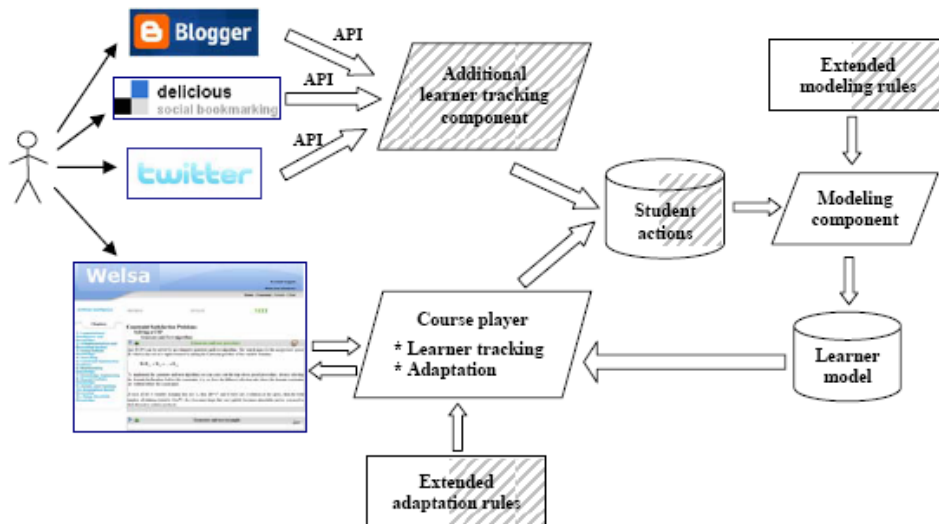


Fig. 4 – WELSA 2.0 schematic architecture (grey shaded areas represent extensions from WELSA 1.0).

- an *additional learner tracking component*, which uses the APIs or RSS feeds provided by Blogger, Delicious and Twitter respectively, to retrieve learner actions and store them in the WELSA database
- the *Student actions database*, covering a wider range of student actions (e.g., *login\_blog*, *login\_twitter*, *login\_delicious*, *post\_blog\_message*, *post\_blog\_comment*, *post\_tweet*, *add\_bookmark* etc.)
- the extended *Modeling and Adaptation rules*, accommodating the social and collaborative preferences of the students.

#### 4.2. Extending the Modeling Component

As already noted, with the introduction of the three new tools, the range of student actions monitored and recorded by the system is extended, which leads to an increase in the number (and variety) of behavioral patterns that can be computed. WELSA 1.0 already takes into account over 100 behavioral indicators, referring to:

- Educational resources (*i.e.*, learning objects - LOs) that compose the course: time spent on each LO, number of accesses to an LO, number of skipped LOs, results obtained to evaluation tests, order of visiting the LOs. For each LO we have access to its metadata file, including information regarding the instructional role (e.g., 'Definition', 'Example', 'Exercise', 'Interactivity', 'Illustration' etc.), the media type (e.g., 'Text', 'Sound', 'Image', 'Video'), the level of abstractness and formality etc.;
- Navigation choices: either linear, by means of the 'Next' and 'Previous' buttons or nonlinear, by means of the course Outline;
- Communication tools - a synchronous one (chat) and an asynchronous one (forum): time, number of visits, number of messages.

Once we introduce the Web 2.0 tools, the range of behavioral patterns is extended by adding social and collaboration indicators: number of blog posts, number of blog comments, number of tweets, number of bookmarks added, time spent on the blog, frequency of accesses to the social bookmarking tool etc. Consequently, the modeling rules have to be refined to take into consideration the new behavioral indicators. A first step in this respect would be to perform an experimental study with the students, monitoring and recording all their interactions with WELSA 2.0. Next, statistical analysis should be applied on the data to identify correlations between the newly introduced behavioral indicators and students' ULSM preferences, following the approach proposed in [15]; these correlations will represent the basis for the new modeling rules. Based on our previous findings [16], we expect that a higher number of available patterns will also lead to a higher accuracy of the learning style diagnosis.

Just as in case of WELSA 1.0, teachers will have the possibility to adjust the new modeling rules to conform to the specificities of the course at

hand (*e.g.*, a course whose assignments rely heavily on the use of blog will place a high weight on the *number\_of\_blog\_posts* behavioral indicator; a course not requiring the use of microblogging will eliminate all Twitter-related behavioral indicators from the modeling rules etc.).

Furthermore, since the social and collaborative behavioral indicators are stored in WELSA database together with the rest of the students' behavioral patterns, the data analysis tool will be able to automatically include them in the aggregated data that it offers to the teachers for visualization (*e.g.*, number of each action type per student, time spent using each tool, length of blog contributions etc.). This information can be used by the teachers for comparisons, grading, statistical purposes. Obviously, only quantitative data can be provided by the system; as far as qualitative analysis is concerned, this has to be performed by the teachers (by manually inspecting the actual content contributed by the students in the Web 2.0 tools). Parts of this task could also be automated (*e.g.*, natural language processing, content analysis for Web 2.0 [28]) but this is outside the scope of our system.

#### 4.3. Extending the Adaptation Component

As mentioned in the previous section, WELSA 1.0 supports only navigation and presentation level adaptation. In WELSA 2.0, the range of adaptation actions could be extended to incorporate also collaboration level adaptation.

Two extension directions are envisaged:

- First of all, recommendations can be given for group formation based on students' learning styles. Similar works in this area include: [1], [5], [14];
- Secondly, recommendations can be offered regarding the most suitable Web 2.0 tool for each student and each task. Some steps in this respect are reported in [6], [21] and [22], which investigate the connections between learning styles and students' preferences towards Web 2.0 tools.

It is important to mention that expanding the range of adaptation actions will not imply an increase in the teacher's workload; the adaptation is done automatically by the system, based on the built-in rules. Of course, just as in case of WELSA 1.0, teachers will have the possibility to fine-tune the newly added adaptation rules (*e.g.*, define specific constraints for group formation).

### 5. Conclusions

We started this paper with a short presentation of the implications of Web 2.0 for education, outlining some practical guidelines for the use of social software tools to support teaching and learning; a successful case study was also reported. Next, we presented an overview of WELSA educational system, focusing on its learner modeling method and adaptation provisioning

techniques. We then showed how a social dimension can be added to WELSA 1.0, by integrating a set of Web 2.0 tools (blog, social bookmarking tool, microblogging tool).

As future work, we plan to complete the prototype implementation of WELSA 2.0 and perform experiments with students to validate the new platform (i.e., assess the accuracy of the modeling method as well as the efficiency and effectiveness of the adaptation actions on the learning process). The encouraging results obtained with WELSA 1.0 (as reported in [19]), corroborated with our students' positive attitude towards the use of Web 2.0 tools in education (as reported in [20]), lead us to believe that the new WELSA 2.0 system will prove beneficial to the learning process.

**A c k n o w l e d g e m e n t s.** This work was supported by the strategic grant POSDRU/89/1.5/S/61968, Project ID 61968 (2009), co-financed by the European Social Fund within the Sectorial Operational Program Human Resources Development 2007 – 2013.

Received: November 12, 2010

University of Craiova, Romania,  
Software Engineering Department  
e-mail: epopescu@software.ucv.ro

## REFERENCES

1. Alfonseca E., Carro R.M., Martin E., Ortigosa A., Paredes P., *The Impact of Learning Styles on Student Grouping for Collaborative Learning: a Case Study*. User Modeling and User-Adapted Interaction: The Journal of Personalization Research. Special issue on User Modeling to Support Groups, Communities and Collaboration, **16**, 3-4, 377–401, 2006.
2. Anderson P., *What is Web 2.0? Ideas, Technologies and Implications for Education*. Technical report, JISC, available at: [www.jisc.ac.uk/media/documents/techwatch/tsw0701b.pdf](http://www.jisc.ac.uk/media/documents/techwatch/tsw0701b.pdf), 2007.
3. Beemer B., Gregg D., *Mashups: A Literature Review and Classification Framework*. Future Internet, **1**, 1, 59–87, 2009.
4. Brusilovsky P., Karagiannidis C., Sampson D., *Layered Evaluation of Adaptive Learning Systems*. International Journal for Continuing Engineering Education and Life-Long Learning, **14**, 4/5, 402–421, 2004.
5. Christodouloupoulos C., Papanikolaou K., *A Group Formation Tool in an E-Learning Context*. Proc. ICTAI 2007, 117–123, 2007.
6. Derntl M., Graf S., *Impact of Learning Styles on Student Blogging Behavior*. Proc. ICALT 2009, IEEE Computer Society Press, 369–373, 2009.
7. Downes S., *E-Learning 2.0*. eLearn Magazine, New York, available at: <http://www.downes.ca/post/31741>, 2005.
8. Drachsler H., Pecceu D., Arts T., Hutten E., Rutledge L., Van Rosmalen P. *et al.*, *ReMashed-Recommendations for Mash-Up Personal Learning Environments*. Proc. EC-TEL 2009, LNCS 5794, Springer, 788–793, 2009.

9. Graf S., *Adaptivity in Learning Management Systems Focussing on Learning Styles*. Ph. D. Diss., Vienna University of Technology, Austria, 2007.
10. Grodecka K., Wild F., Kieslinger B., *How to Use Social Software in Higher Education*. iCamp handbook, available at: <http://www.icamp.eu/wp-content/uploads/2009/01/icamp-handbook-web.pdf>, 2009.
11. Homola M., Kubincova Z., *Taking Advantage of Web 2.0 in Organized Education (A Survey)*. Proc. ICL 2009, 741–752, 2009.
12. O' Reilly T., *What Is Web 2.0. Design Patterns and Business Models for the Next Generation of Software*. Available at: [www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html](http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html), 2005.
13. Ort E., Brydon S., Basler M., *Mashup Styles*. Available at: [http://java.sun.com/developer/technicalArticles/J2EE/mashup\\_1](http://java.sun.com/developer/technicalArticles/J2EE/mashup_1), 2007.
14. Paredes P., Ortigosa A., Rodriguez P., *TOGETHER: an Authoring Tool for Group Formation Based on Learning Styles*. Proc. A3H (7th International Workshop on Authoring of Adaptive and Adaptable Hypermedia at EC-TEL 2009), 2009.
15. Popescu E., *Learning Styles and Behavioral Differences in Web-Based Learning Settings*. Proc. ICALT 2009, IEEE Computer Society Press, 446–450, 2009.
16. Popescu E., *Diagnosing Students' Learning Style in an Educational Hypermedia System*. Cognitive and Emotional Processes in Web-based Education: Integrating Human Factors and Personalization, Advances in Web-Based Learning Book Series, IGI Global, 187–208, 2009.
17. Popescu E., Badica C., Moraret L., *WELSA: An Intelligent and Adaptive Web-Based Educational System*. Proc. IDC 2009, SCI 237, Springer, 175–185, 2009.
18. Popescu E., *A Unified Learning Style Model for Technology-Enhanced Learning: What, Why and How?* International Journal of Distance Education Technologies (IJDET), **8**, 3, IGI Global, 65–81, 2010.
19. Popescu E., *Adaptation Provisioning with Respect to Learning Styles in a Web-Based Educational System: An Experimental Study*. Journal of Computer Assisted Learning, **26**, 4, Wiley, 243–257, 2010.
20. Popescu E., *Students' Acceptance of Web 2.0 Technologies in Higher Education: Findings from a Survey in a Romanian University*. Proc. DEXA 2010 Workshops, IEEE Computer Society Press, 92–96, 2010.
21. Saeed N., Yang Y., *Using Learning Styles and Preferences to Incorporate Emerging E-Learning Tools in Teaching*. Proc. ICALT 2008, IEEE Computer Society Press, 967–971, 2008.
22. Saeed N., Yang Y., Sinnappan S., *Effects of Cognitive Style on User Acceptance of Blogs and Podcasts*. Proc. ICALT 2009, IEEE CS Press, 293–297, 2009.
23. Small G., Vorgan G., *iBrain: Surviving the Technological Alteration of the Modern Mind*. HarperCollins, 2008.
24. Ullrich C., Borau K., Luo H., Tan X., Shen L., Shen R., *Why Web 2.0 is Good for Learning and for Research: Principles and Prototypes*. Proc. WWW '08, ACM Press, 705–714, 2008.
25. Vygotsky L.S., *Mind in Society*. Harvard University Press, Cambridge, MA, 1978.
26. Wild F., *Mash-Up Personal Learning Environments*. iCamp project deliverable, available at: [http://www.icamp.eu/wp-content/uploads/2009/01/d34\\_icamp\\_final.pdf](http://www.icamp.eu/wp-content/uploads/2009/01/d34_icamp_final.pdf), 2009.

27. \* \* *Blogger*. Available at: <http://www.blogger.com>, last accessed on November 5, 2010.
28. \* \* *CAW 2.0*. Content Analysis for the Web 2.0, available at: <http://caw2.barcelonamedia.org/>, last accessed on November 5, 2010.
29. \* \* *Delicious*. Available at: <http://delicious.com/>, last accessed on November 5, 2010.
30. \* \* *Learnovation. Foresight report*. Available at: [http://www.elearningeuropa.info/files/lo/Learnovation\\_foresight.pdf](http://www.elearningeuropa.info/files/lo/Learnovation_foresight.pdf), 2009.
31. \* \* *Twitter*. Available at: <http://twitter.com/>, last accessed on November 5, 2010.

## DE LA WELSA 1.0 LA WELSA 2.0: INTEGRAREA DE ELEMENTE DE ÎNVĂȚARE SOCIALĂ

(Rezumat)

Într-o lume în care Internetul este prezent pretutindeni și permanent, studenții sunt și ei în continuă schimbare: așa numiții *digital natives* (persoane născute și crescute după apariția și dezvoltarea tehnologiilor digitale) vor să fie în continuă comunicare cu ceilalți studenți, își doresc o instruire individualizată și un mediu de învățare personalizat, care să se adapteze în mod automat la nevoile fiecăruia. De aici necesitatea de a oferi platforme de e-learning inteligente, unde studenții să poată învăța într-un mod personalizat, prin colaborare și interacțiune cu profesorii și colegii lor (așa numitele medii de învățare sociale și adaptive).

Un prim pas în acest sens a fost realizat prin crearea platformei adaptive de e-learning WELSA (*Web-based Educational System with Learning Style Adaptation*), care oferă cursuri individualizate conform stilului de învățare al fiecărui student. Primei versiuni a sistemului (WELSA 1.0) îi lipsește însă dimensiunea socială, prin care studenții să poată interacționa cu ceilalți, însușindu-și cunoștințele prin eforturi colaborative. De aceea s-a optat pentru extinderea sistemului cu elemente de învățare socială, prin integrarea de instrumente Web 2.0. Abordarea este motivată de faptul că în ultimii câțiva ani aceste instrumente software sociale au început să fie folosite în educație, cu rezultate încurajatoare (în ceea ce privește satisfacția studenților, acumularea de cunoștințe și/sau eficiența procesului de învățare). Din punct de vedere tehnic, soluția propusă se bazează pe *mashup*-uri (combinarea de date și/sau funcționalități din două sau mai multe surse externe pentru a crea o nouă aplicație Web). Cele 3 instrumente (blog, sistem de *social bookmarking*, sistem de *microblogging*), sunt integrate ca *widget*-uri în platformă, iar preluarea datelor se face prin *API*-urile asociate.

Lucrarea se deschide cu o discuție despre impactul pe care Web 2.0 îl are asupra educației, incluzând și un studiu de caz realizat în cadrul Universității din Craiova. Este prezentat apoi pe scurt sistemul WELSA 1.0, insistându-se asupra componentelor de modelare a studentului și adaptare. În final, este descrisă soluția pentru integrarea instrumentelor Web 2.0 în noul WELSA 2.0, fiind specificate extensiile necesare pentru fiecare componentă a sistemului. Ca direcții viitoare de cercetare se au în vedere finalizarea și testarea prototipului WELSA 2.0.