eLearning 2.0 – Technologies for Knowledge Transfer in European-Wide Network of Schools

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***Abstract* — With the upcoming features of Web 2.0 current eLearning solutions, mostly characterized by single user and centered data-download, change and develop further. The traditional paradigm of classroom teaching and learning is broadened towards sharing experiences and knowledge in word-wide social communities. Furthermore, knowledge capturing in ambient environments gains more importance and the use of mobile devices has created rich and exciting learning opportunities. These aspects characterize the so-called eLearning 2.0. Different aspects of this paradigm shift are presented in this paper and the European Community supported UNITE project as an application case is offered. The technical aspects of the platform development cycle are provided and its enhanced eKnowledge repositories are addressed. The UNITE system implementation in the setting of one of the European-wide network of schools is presented as an iterative four-stage-process, the achieved results are discussed and future work is proposed.**

***Index Terms* — Web 2.0, eLearning 2.0, knowledge management, e/mLearning implementation process, case study**

I. Introduction

Currently eLearning solutions are mostly based on the Web 1.0 paradigm characterized by single user and centered data-download. With the upcoming features of Web 2.0, this situation changes completely. Support of communities along with communicating and collaborating user groups become prevalent. Moreover, these user groups also upload data to the web and, herewith, the Web becomes a medium for group-based interaction. Consequently, eLearning area changes and develops further. Different aspects of this paradigm shift are presented and the European Community supported project UNITE [1] as an application case is offered.

The paper is structured as follows: Section 2 provides background to the research along with challenges of eLearning 2.0. Section 3 concentrates on the technical aspects of the development cycle of eLearning 2.0 platforms, whereas section 4 focuses on enhanced eKnowledge repositories. Section 5 describes the implementation of the e/mLearning platform in the one of European-wide network of schools. Finally, Section 6 concludes the paper offering in addition directions for future research.

II. Background to the Research and Challenges

eLearning system usually implies the platform, pedagogy behind it and scenarios in various application domains. Several often used platforms like Moodle [2], Blackboard [3] and Ilias [4] are based on a client/server architecture. eContent is stored on server side management systems and delivered to learners on the client side. Courses are frequently made out of sequences of pages and atomic assets. To support searching and classification, content can be annotated with standardized meta-data (Learning Object Metadata, LOM). The pedagogical basis of an eLearning system regularly lies upon the traditional model of classroom learning and homework. Application domains are pre-defined by eLearning providers and delivered as pre-fabricated pieces of learning material. Interdisciplinary use of this kind of a system is either impossible or very challenging.

A. Mobile Learning Challenges

The state of the art in eLearning environments is defined by computers with Internet-connection. This technology of web-based trainings (WBTs) is well known and conceptually mature. However, with the upcoming Web 2.0, the usage of mobiles as devices for both downloading content as for uploading results or input (see e.g. Flickr [5]) becomes more and more prevalent. With this trend the challenge is in the development of eLearning solutions taking the integration of mobile learning into consideration. The use of mobile devices can and indeed has created rich and exciting learning opportunities. In order to identify the driving forces behind innovative learning practices, special focus should be placed on three different learning domains: (i) enhancement of teaching practice with ubiquitous technologies in teacher education, (ii) collaborative mobile learning games in corporate settings and (iii) people on the move in a disturbed environment [6]. We find that these domains outstandingly underline three very important spheres of future research efforts of the technology-enhanced learning area.

B. Learning Paradigm Shift

Considering the number of eLearning platforms, the traditional classroom-metaphor of learning is still prevalent. Contents are delivered to the students, and the students can download the materials from the platform. Interaction among students and the teachers is rather rare. Innovative Web 2.0 technologies for cooperative and collaborative work, such as voice and video over IP, and mLearning play only a marginal role, although the benefits through the possibilities of collaborative learning with these tools are promising.

Informal learning today becomes the dominant form of learning [7]. The principles of the Web 2.0, like the ability to connect people, to distribute information world wide and discussing ideas with people from all over the world, have similarities to modern educational theories [8]. Constructivist Perspectives [9] and Activity Theory [10] in particular emphasise the importance of learning active, while methods like cooperative learning [11; 12; 13] and problem-based learning [14] in real-world contexts (situated learning) [15] as well as learning through games and entertainment [16; 17] become more and more popular. In contrast, eLearning systems are still frequently used in a teacher centred way (transmissive learning) and less for self-regulated [18] learning, reflection, social and communication skills and problem solving capacities [19]. With these new approaches, the role of the teacher shifts to facilitator, while the learners leave their former passive role and start to embrace an active involvement in the learning process.

C. Learning Scenarios and Standardisation

Traditional eLearning scenarios focus on enhancing the learning process in the classroom or support learning at home. With mLearning groups of learners can participate in real life, and at the same time get guidance via their mobile device by solving problem-based scenarios. Another problem of the traditional scenarios is the non-standardisation of the scenarios. Standardisation makes the principles of the scenario explicit and therefore accessible for evaluation. A comparison of different scenarios is possible and hence best practice approaches can be identified. A propos, standardisation is sometimes confounded with inflexibility. This may result from a narrow understanding of the term standardisation. The standardisation can be general enough to embrace nearly all teaching processes. For new teaching approaches new standards will be derived using abstract meta-scenarios. Another advantage is the reusability of standardised scenarios for new learning projects.

To sum up, next generation eLearning (eLearning 2.0) will extend all the above mentioned aspects. Scenarios will take into account the collaboration of heterogeneous groups. The classical roles of teacher, tutor and learner will disappear and will advance towards situated skill sharing with dynamic roles of *skill providers* and *skill consumers*. This leads to requirements new eKnowledge repositories have to deal with. Hence, to be in line with this discussion, the UNITE eKnowledge repositories are addressed in Section 4, while a Web 2.0 eLearning platform used in European-wide network of schools is described in the successive one.

III. TECHNICAL DEVELOPMENT PROCESS

UNITE (Unified eLearning environment for the school) is a thirty-month project partially supported by the European Community under the Information Society Technologies (IST) priority of the 6th Framework Programme for R&D (www.unite-ist.org). Project is aiming to provide novel services in education for young Europeans by combining different state-of-the-art technologies in e/mLearning, also taking into consideration innovation in technology and pedagogy.

The main goal of UNITE is "to contribute to the improvement of Europe-wide education in secondary schools based on common, innovative principles in technology, pedagogy and in learning scenarios, tested by a well-defined validation framework" [20]. In order to achieve this goal, a number of key objectives were set up: (i) the *pedagogical framework*, designed and implemented in the first phase, initiates daily use of the UNITE platform in classrooms and provides pedagogical concepts for the eLearning scenarios; (ii) the *technical platform* with its communication and cooperation functionalities supports wide-spread learning along with other learning concepts of the designed pedagogical framework; (iii) the *learning scenarios* use full potential of the platform and develop pedagogical concepts in order to motivate learners and deliver innovation in the classroom. It is important to note that other projects' objectives concern the establishment of a *Network of Schools*, the development of a Europe-wide repository of *re-usable m/eLearning content*, the development of an adequate *validation framework*, detailed *socio-economic evaluation* as well as delivery of an *exploitation plan*.

A. Functional Design and System Architecture

A Web 2.0 eLearning UNITE platform seamlessly integrates three distinct technologies including their diverse functionalities into usable and effective e/mLearning environment [21]: (i) an *eLearning portal*, supporting the learning process and specifically, group-oriented learning in classes of pupils, (ii) an *eKnowledge repository*, containing traditional eLearning material (like assets, pages and courses), but also images shot during "learning at excursions", knowledge sharing sessions and best practices and (iii) a *mobile learning component*, that allows to contact both learners and the school-server (publishing the material) and to communicate in a way mobile learning scenario implies.

From a system design point of view, modularity and re-usability are the key points. Modern Web-based systems are therefore based on a web Service Oriented Architecture (SOA). This supports the configuration and integration of the systems based on the functionality of services avoiding any implementation detail. The UNITE platform implements addressed concepts providing system-architecture which covers a service oriented and extendible pool of software-components: *Microcosmos* [22], the eLearning repository *Infopool* [23] and *mediaBoard* [24]. There are two access points: the learning portal and the learning management system are directly accessed via a web server (http://pilot.unite-ist.org), while the mobile devices are connected to the platform via a dial-in server. The knowledge repository is a background service behind the web server.

B. Interactions within the UNITE Platform

Users can perform different activities and interactions with the UNITE platform according to their access permissions. User's role is a virtual set of characteristics, built to arrange and control the access rights of particular system user [21]. Once a role has been assigned, the users gain all respective access rights. There are six default roles in UNITE, while new custom roles can be easily created by the administrators. The default roles are: *System Administrator* (s/he has full access permission "to everything"), *Administrator* (s/he has full access permission to everything except for access to System Administrator Management pages), *Teacher* (s/he creates/edits/deletes users, groups, roles, workspaces, tasks, quizzes etc.), *Student* (s/he can view workspaces, tasks, quizzes, forums; view/create/edit/delete/upload files in the InfoPool area etc.), *Parent* (s/he can also view workspaces, tasks, quizzes, forums; view/create/edit/delete/upload files in the InfoPool area etc.) and *Unauthorized* (s/he can view only public information).

The system observes users' access to the different service-based technologies. All relevant interactions are registered by an event-driven observer that provides the possibility to analyse the user interactions by observing user failures, usage frequency of the components, way of interaction, time of interaction and type of task. These data are now used to create statistics about the usage behavior and subsequently to improve the whole system by identifying possible system errors. Different registered activities provide the following information: date, time and type of activity, the user and its IP address (used as country identifier) and description.

The interactions realized by diverse UNITE users (activities like creating new learning material or making mistakes by using several functionalities of the system) are highlighted with different colours in order to gather the required information better, see Figure 1.

Collected user-interaction information is used for system improvement together with the suggestions for new activities or components based on the recorded history. For such suggestions, probabilistic methods like the Hidden-Markov-Model (HMM) [25] can be used in order to compute probabilities of usage. The system analyses the different activities of the user and suggests an accurate next step or activity computed by the previous activities. Additionally, the system automatically recognizes if a user needs help, providing her/him the needed information.

Figure 1. Activity log in UNITE

C. System Design and Development

The usage of authoring clients for the creation of new content, especially courses, is a great challenge if the system should be used by different users from different countries. For a successful design of authoring software, where the precognition and experiences of the users are critical, the users have to be involved in the development process. Different existing empirical and analytical methods of evaluation offer accurate models to evaluate tools in iterative processes and make them more usable and suitable for the users [26; 27], whereas users are mostly not directly involved in the development process.

In the UNITE project a new process model was developed to combine analytical evaluation methods with the rapid prototyping for creating easy-to-use full-graphical authoring clients. The software development process foresees five different stages that create an iterative circle of development [28], as illustrated in Figure 2.

Step 1: Users' Feedback

End users are usually not able to define the system requirements a priori and in a precise manner. Therefore, the iterative development process starts with a first rapid prototype based on the experience of both the system developers as well as the end users. This first prototype had only limited functionalities, but it gave the main functionality (e.g. courses creation). It was published on a web, where the users were asked to create a course and to provide informal feedback. A web-based communication portal and the employed think-aloud strategy [27] enabled users to freely express everything they wanted, to ask questions and to make suggestions for improvement.

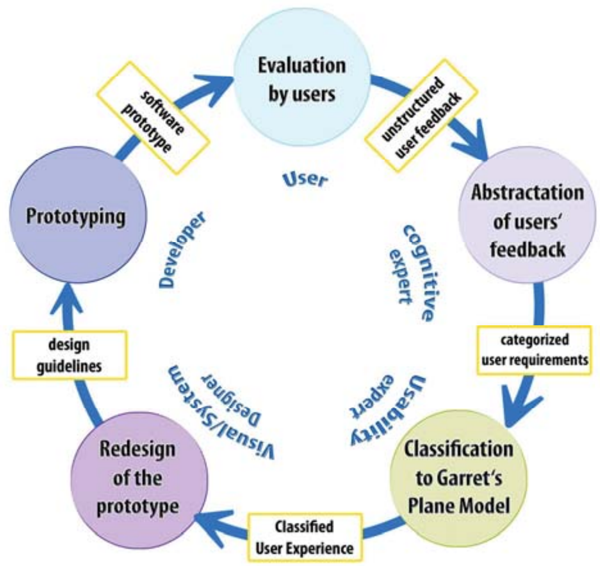

Figure 2. Process model of user-centered software design [28]

Step 2: Categorization & Abstraction of Users' Feedback

We experienced that, in order to identify real problems, provided users' feedback can be categorized. Namely, because different users described the same problem in completely diverse ways, their feedback was categorized in abstract "classes". This abstract definition of the users' feedback was taken as basis for the Garret's Plane-Model strategy [29]. The Plane-Model allows the identification where the core of the main problem is. It is divided in five planes for understanding issues related to user experience in web-based systems. A problem brought up by end users was assigned to one or more planes of the model. This strategy made sure that all aspects of users' requirements are considered.

Step 3: Classification according to Garret's Plane-Model

Identification of problems and their classification according to Plane-Model are analytical work. For a better understanding of users' evaluation feedback and a more precise classification of identified difficulties to the Plane-Model, it was necessary to go through the UNITE prototype and try to think how a particular user tried to find a way out of the situation. Such kind of processing, comparable to cognitive walkthroughs [30], provided an efficient way to identify users' needs and aspirations.

Step 4: Redesign of the Prototype

Following the allocation of core issues of the users' feedback according to the Plane-Model, the redesign of the identified issues started. The UNITE prototype redesign led to changes in functionality, visual design or structure of the web-application, regarding each identified plane.

Step 5: Prototyping

The last step of process model of user-centered UNITE design was the implementation of the improved redesigned prototype. With the usage of the new prototype, the next iteration loop started again.

D. Sytem Validation

In order to verify the validity of technological and pedagogical developments, the validation of the UNITE platform and its e/mLearning scenarios was performed. The validation results showed the appropriateness, meaningfulness and usefulness of both the system and the scenarios [31]. In the following we refer to the procedure and end-results of the platform validation.

Iterative user-centered system design comprised an evaluation methodology [32], by means of which relevant platform characteristics were quantified, validated and weaknesses identified. Both low-fidelity (paper-based) and high fidelity (computer-based or interactive) prototypes of the platform were tested by UNITE users. A total of 62 teachers and 131 pupils (ranging between 11 and 18 years of age) involved in the project along with 28 partner members and observers participated in two iterations of the evaluation. In addition, 5 double experts from the usability and eLearning field (not directly involved in the project) were employed also.

The evaluation procedure of the UNITE system comprised (i) *heuristic evaluation* and (ii) *scenario-based usability testing*, including pre-experiment multi-choice questionnaire, task-based user testing, memory test, usability satisfaction questionnaire and semi-structured interview. In order to make a decision regarding whether or not there is sufficient evidence that the platform has met its objectives, several goals were set up. For example, *accuracy of task completion*, as objective performance measurement of effectiveness in using the platform, for students was 78.3% and for teachers 70.59%, while *task completion time*, as objective performance measurement of efficiency in system usage, for five key tasks for students was 14.75 minutes and for teachers 24 minutes (our goal was to make it under 20 and 30 min respectively). The overall conclusion is that UNITE has a huge potential as a powerful and integrated teaching and learning system although it would benefit from some alterations (*ibid.*).

IV. Enhanced eKnowledge Repositories

As already emphasized, there is a fundamental further development from traditional eLearning content towards Web 2.0 material. Web 2.0 is much more focused on the knowledge sharing between heterogeneous communities. Because Internet technologies are used, the term "eKnowledge" will be used in the following.

A. eKnowledge Domains

In eLearning 2.0, content includes not only traditional SCORM-compliant eLearning content (assets, pages and complete courses), but, in addition, mLearning content (images shot using mobiles or handhelds), information about groups and results of collaborative learning. All information can be tagged with meta-data and, herewith, can be searched using terms like keywords, authors and the like. Keywords can be assigned either individually, or based on commonly agreed glossary. This allows the uniform categorization of data and, herewith, the re-use on a European-wide scale.

On top of the meta-data, *eKnowledge domains* or *eLearning contexts* are defined. An eKnowledge domain is, using semantic web terminology, defined as ontology, consisting of topics and associations between them. The topics consist of categories of meta-data, while the associations describe the relations between them. An eKnowledge domain forms a semantic space, in which the meta-data as well as the data have a context-specific meaning. Correspondingly, the same data and meta-data may have different meaning in different knowledge domains. In UNITE, eLearning contexts are defined as *reference scenarios*. Consequently, topics, associations and meta-data have a context-specific meaning.

To manage eKnowledge content, an eKnowledge repository must handle all the content types above as first class entities. In UNITE, the eKnowledge repository is based on a traditional eLearning repository, extended by the features to deal with content produced by mobile devices, the management of uniform meta-data spaces across different items as well as the management of complex ontologies for both users as well as content.

B. Content Patterns

Re-usability and *uniform layout* are key requirements in eLearning. Because content production is very expensive the re-use of whole courses or at least parts is essential. eLearning content often has to follow a certain Corporate Identity (CI) what makes adaptability necessary. In eLearning 2.0, re-usability and uniform layout become even more crucial, because of the large and heterogeneous groups of content producers and consumers. A solution for these requirements is the usage of *patterns*, as well known from software design. While there may be numerous kinds and types of patterns, UNITE has concentrated on two of them: *page-patterns* and *course-patterns*. Page patterns define the types of pages (like introduction, presentation, quiz, test) as well as their layout (text page, page with graphics/animation, single choice / multiple choice tests and the like). These page patterns are described in UNITE's teachers' handbook and form a general guideline for the production of content.

Course-patterns are a new concept, first introduced in UNITE. A course is a learning unit that can be executed and navigated. Currently, simple sequencing, the standardized way of navigation, is implemented. A course consists of different types of course elements (such as modules, questions), which reference locations and meta-data in the repository. Because there are just references, content can easily be shared among different courses. Courses themselves are treated as first class elements of the eKnowledge repository. They have specific meta-data that can serve as search criteria. Courses can be re-used "as-is" or can be modified. Moreover, abstract course templates can be modeled and stored as *course patterns*. These patterns define only a navigation structure through different course elements, but have no content yet. They can be *instantiated* with specific content in the same or in different contexts.

The combination of both, page patterns and course patterns, allows the creation of courses with the same look and feel for different pedagogic situations, a prerequisite for a wide network of schools with different knowledge domains.

C. eKnowledge Management Tools

UNITE provides tools for the management of the eKnowledge repository: a meta-data editor and a course editor. The web-based meta-data editor is based on the international standard LOM and can be configured to cover just the necessary data for a specific knowledge domain, and, herewith, allows annotation with minimal efforts and maximal confidence, because only the formally correct key word dictionary is provided. Key words are stored in a dictionary and a search engine is integrated in the editor.

The platform also provides an interactive *course editor*, a web-based application managing courses as XML files. Courses can be created by drag&drop of the course elements; different course elements can be distinguished by different colors. A meta-data search engine is integrated, so that content can be searched for during the course creation process. Apparently, UNITE serves as an enhanced eKnowledge repository with special focus on collaborative and explorative learning along reference scenarios.

Other than *course editor*, Figure 3 shows screenshots of the further two important platform elements. The *InfoPool* repository is the container for all e/mLearning contents. It provides the common content management facilities to manage the platform contents: users are able to create, delete and modify courses, SMS quizzes, external links, cut, copy and paste files and folders, set folder permissions and enter metadata to the InfoPool's contents. The mLearning component of the platform is represented by the *mediaBoard*. Students and tutors are able to configure their own mediaBoard: they can change its name, select a base image, add zones to the board, and select permission settings. Users can then send messages, audio recordings or images to the mediaBoard, either directly from the website, via email, SMS text message or MMS message.

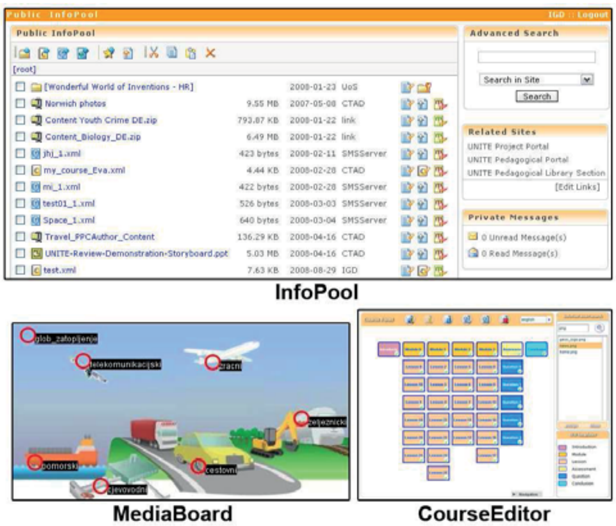

Figure 3. The UNITE platform

The implementation of UNITE system in the setting of one school from the European-wide network is presented in the following section.

V. Implementation of UNITE in School Settings

In previous sections the platform's numerous possibilities for successful knowledge delivery and acquisition are pointed out. It is up to teachers and schools how they will make use of them. Consequently, the e/mLearning implementation phase comprises joint work of project partners and partner schools related to setting up the infrastructure, planning, creation and delivery of new and/or customized scenarios as well as validation of performed activities in the network of 14 European schools. This section presents a case study of the e/mLearning implementation of theories and practices in one of the schools.

As any other good-practice project, UNITE has followed a certain process in order to implement its theories and practices in schools. It somehow matches the idea behind Deming's iterative four-step problem-solving *Plan-Do-Check-Act* (PDCA) or *Plan-Do-Study-Act* (PDSA) process [33]. Aligning with the PDSA cycle, UNITE's implementation process advances through four major phases [34]: (i) scenario planning, (ii) scenario implementation, (iii) validation and (iv) platform and process improvement respectively (see Figure 4).

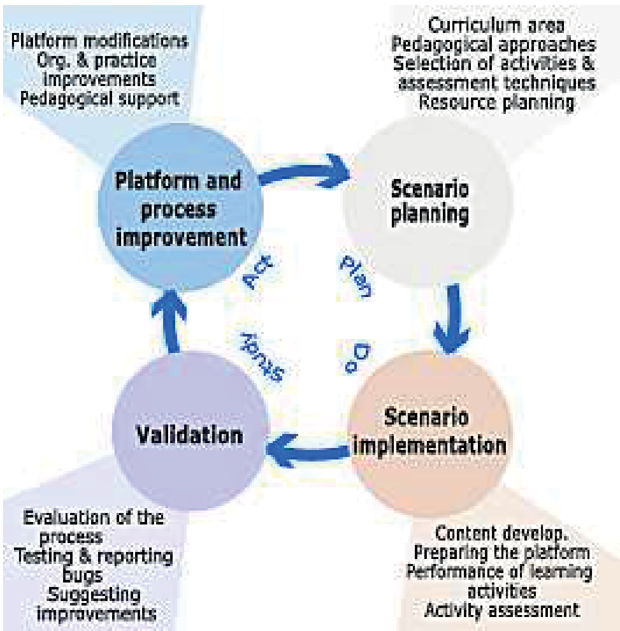

Figure 4. The launch of UNITE in schools [34]

A fundamental principle of this four-stage-process is iteration: once our assumptions were confirmed or negated in the validation phase, we execute the cycle once again. The results from first iteration, the one that took place in school Spinut from February 2007 to June 2008 are presented in the following section. A team of five people consisting of the school's headmaster, the pedagogue and three subject teachers was formed. Support in terms of organizational and technical assistance was provided by University of Split (UoS), one of 13 project partners. In the first two scenario implementations approximately 50 students took part (mostly 13 and 14 year-olds).

A. Scenario Planning

The objective of the *scenario planning phase* was the delivery of two innovative scenarios: (i) the custom scenario, planned and written using the scenario template and (ii) the adapted one, an adjusted scenario sample which¸ fits the curriculum. In general, the UNITE scenario template consists of two parts, one related to the curriculum area and the other to the pedagogical activities planned to take place during the scenario implementation. Every activity matches its learning objective, the tools/resources, the intended assessment technique and its time span [35]. The outcome of this phase was a paper-based version of the two scenarios developed according to the teachers' understanding of pedagogical and technological considerations.

B. Scenario Implementation

The *scenario implementation phase* encompassed the development of e/mLearning content, the preparation of the UNITE platform along with the performance of learning activities from the scenario using the platform and mobile devices. This phase can be perceived as testing the scenario against the platform. The most relevant material (tools and resources) collected by teachers were subsequently employed in the course preparation, hence being available for those who wanted to know more about related subject matter (for this purpose modules *Course Editor* and *Course Viewer* were used) (*ibid*.).

Six groups of approximately equal numbers of students aged 13 and 14 were formed. Student assignments were placed within the system (module *Tasks*) and appropriate instructions were provided. Students consulted their online textbooks, Internet sources and their teachers in order to find material related to the problem defined in their assignment. Most relevant resources they found were placed in the platform using mobiles, PDAs, laptops and PCs (modules *InfoPool* and *mediaBoard*). Moreover, by means of *Metadata editor* related metadata was attached as well. UoS provided support to students as technical expert/advisor throughout few workshops and through the platform (using *my Messages*, *Chat* and *Forum*). Undertaken activities enabled students to express their own competence and knowledge about various aspects of related subject matter and about system too.

C. Validation

The objective of the *validation phase* was to monitor and evaluate the process and achieved results against the goals, reporting the outcome in *case record* format. The most valuable validation feedback came from the case records. One form was completed by every teacher, while most of the students completed the questionnaire either as individual or group exercise. Teachers were concerned about assigning additional tasks to students not actually contributing to a group work in any way. Overall, while teachers were very satisfied with students' interest in these new ways of communication and teaching, students did not share their opinion. Namely, their communication with their teachers mostly took place in classroom and it was not on-line. The possibility to communicate with students from other European schools was in students' opinion a great advantage of this shared platform.

Students found extremely useful and fun to use their mobile phones for learning, although they were worried about related costs. Mobile phone usage was very familiar to students; it helped to steer their interest and increased their motivation for platform usage. Moreover, an employment of phones was very effective since it was used as a different way of collecting data related to subject matter. According to students' comments and our personal opinion, they were very satisfied with the platform, eLearning and mLearning in general.

D. Platform and Process Improvement

The *improvement phase* enabled revisions along with modification/enhancement of the previous UNITE's implementation process phases, just before the start of a next iteration. Based on timely validation information from the *Network of Schools* and earlier planning, there are already several platform improvements available, categorized mostly in four main areas: stability, user interface, functionality and performance. To exemplify, one of recently introduced functionalities is *MyLearning author for Pocket PC*, an authoring tool that allows teachers to create learning materials for Pocket PCs and Smart Phones.

In addition to platform improvements, supplementary modifications in terms of organizational nature (e.g. platform will be used as a tool during the whole semester for all lessons from one subject and not only for the selected ones) and pedagogical support (e.g. new portal for teachers is available) are provided as well.

VI. Conclusion and Future Work

The experimentation and learning processes of students are supported by different technologies, which use the surplus of the changing trends in Web 2.0. The Internet's main goal was always the initialization of sharing information and knowledge, whereas the aspect of community-based information sharing found its real entrée with the thoughts and technologies grown with Web 2.0. With each of the innovations in web, the challenge grew to transfer these thoughts for enhancing the learning process with computer and web-based systems. Further new technological possibilities and social changes in Europe gave researchers the task to adapt the innovations to eLearning environments.

Many buzz phrases in the area of Internet technologies like Web 2.0, "Rich Internet Application", "Rich User Experience" and alike made it not easy to understand and transfer the real intentions and changes to learning environments. eLearning 2.0 does not only stand for technologies that proceeded the transfer from web to learning environments, it also describes another way of technological-development where the real user is a part of the whole development process.

Consequently, different aspects of this changing eLearning paradigm are presented under the umbrella of the European Community supported project UNITE. Although the project finished in July 2008, the activities and knowledge transfer in the European-wide network of schools continue. Accordingly, opposite to so-called "classical" methods, peer-to-peer and problem-based learning in real-world contexts along with learning throughout entertainment are additionally employed in real school settings. Moreover, there is an initiative in school Spinut to approach younger students (from 11 to 15 years old) and to particularly stimulate their interest in science and technology (S&T). Namely, current trends in the EU are showing that innovative experiments on science teaching or inquiry learning [36] are proving benefits for education [37].

Within the next UNITE implementation phase an elective course entitled "Wonderful world of inventions" for talented students will be developed further in order to encourage students' desire to learn and to give a playful dimension to the knowledge acquisition through new learning scenario. Within this framework, parallel to the activities performed within the school environment, ones taking place in more informal contexts (e.g. field trips, museums, laboratories and alike) will be undertaken. According to diverse areas/stages of the course, different pedagogical approaches will be implemented. A project work where students are encouraged to take more active role, the role of researchers, and to come up with their own sketches and designs will be conducted. Students will try-out their designs in practice and will actually learn-by-doing. There will be a lot of exploratory learning with elements of cooperative learning in groups, along with some pair-work. The teacher will act mostly as students' mentor and not as a "classical" teacher. Field work, numerous visits and workshops will be a great value-add to this scenario and an opportunity for students to learn in a real-life environment(s).

Consequently, UNITE system is and will be used as an irreplaceable communication platform on the one hand and as a repository of the learning material and problem-based tasks on the other. Both synchronous and asynchronous communication and collaboration platform functionalities are equally important, since some of the courses can be attended by a heterogeneous group of students who attend different classes and have different timetables for their compulsory courses. Furthermore, mobile learning capabilities, notes, journals and similar system functionalities are essential since students are able to track their progress, update their portfolio, reflect, explore and discuss. Along these lines, every student is provided with the opportunity to express her/himself, to experiment, to enhance and gain new knowledge.

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