FINALIZING OF UP2UML PROJECT

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ABSTRACT

The outcomes of the Upskilling UML are represented. Our team participated in this European project funded by the European Commission under the Leonardo da Vinci program between October 2005 and November 2007. The project aims to enhance UML skills for software development in small and medium enterprises. A proper new learning content for UML was designed and developed. Besides, innovative course production tools were applied and new training approaches were tested and their methodological results were delivered. In the context of general description of the project outcomes we represent here the contribution of our team.

I.INTRODUCTION

Long-term success in software development is becoming a big challenge. Development organizations have to bring together the demand for more powerful, higher-quality applications with the market pressure for increasingly rapid development schedules and reduced costs, taking into account the ever-growing range of technologies. In addition, they turn to object-oriented software development approaches and component-based software development which promise to provide benefits such as improved reuse, short development cycles, and a larger return on software development efforts. However, to really benefit from object technology, it has to be applied properly. Therefore, developers do not only have to "think in objects" but also have to be well educated in the relevant technologies.

At the same time envisaging the constantly increasing demands for information services, small and medium software companies in their majority are targeted to deliver information services to other small and medium enterprises (SMEs). SMEs hold a specific niche in the economy and the workforce market as well. Often founded ad hoc, for specific project and without proper selection of team members, such companies gain their maturity during the project. The success of the project and the company itself depend crucially on the capacity to acquire new knowledge and the needed skills. However SMEs, which often have tight development schedules and short release rates, cannot afford the time consuming "traditional" education for their teams. Software organisations and software developing departments in companies of all industrial sectors are looking for new and more efficient ways to deliver and perform training. A survey of the programmes of IT training providers all over Europe showed that up to the present, trainings for the UML notation are only available in the form of traditional training sessions. The urgent need to apply new training strategies that allow on-the-job qualification through work-based learning and training is more than obvious. Until now e-learning especially in SMEs is not as widely spread as it should be. Learning with computers has to follow completely different pedagogical principles. Consider problem orientation as a complete reverse paradigm of traditional didactics

– learning begins with the management of a real-world problem. According to Rosenberg [1], the paradigms of learning have evolved over the years, and we are now facing the knowledge management paradigm which gives the learner the ultimate freedom to handle his own learning process. This status quo is illustrated by the fact that there already exists a great demand for online courseware.

A reasonable question arises: why UML upskilling? It is well known that in a real world environment, there is no a standardized method or technology for the development of multiple systems and applications. However, there are powerful and generic tools, which might serve as a foundation for modelling robust and reliable systems. On such a framework, dedicated specific components can be built up to support the multitude of organizational activities. The industry looks for techniques to automate the production of quality software.

UML, the Unified Modelling Language [2], is a non-proprietary modelling and specification language often used by software developers to describe the functionality, the structure and internal behaviour of software systems. UML has been used in the early stages of model-driven engineering, thus allowing system analysts and software developers to concentrate on more fundamental issues. During the 1990s, object orientation (OO) superseded the structured paradigm as the primary technology paradigm for software development. Nowadays numerous commercially successful modelling tools support most of UML 2.0, leaving only the rarely used features out of implementation. Now during the 2000s the UML diagrams are applied for agile modelling and Agile Software Development (ASD) [3] that appears to supersede traditional prescriptive approaches. Recently both OO and ASD are often used to develop complex systems. In this context UML in its latest version as a general purpose modelling language is not restricted to modelling software only, but it is commonly used for business process modelling and representing the organization hierarchy. The main benefit is that UML facilitates the construction of traceable models in a coherent and communicable way. That is why many companies are incorporating the UML as a standard into their development processes and products. Last but not least the UML is non-proprietary and open to all. It collects best engineering practices that have proven successful in the modelling of large and complex systems [4].

This is the relevance of the Leonardo pilot project "Upskilling to Object-Oriented Software Development with the Unified Modelling Language"(shortly Upskilling UML) [6][1]. The final goal is to meet the needs for proper UML training taking into account the difference in requested knowledge and skills. Supporting SMEs with properly designed educational resources is a very significant task. New Bulgarian University [5] offers courses concerning advanced technological tools – UML, Oracle, J2EE, .NET, etc. This justifies our participation in the project.

The rest of the paper is organized as follows. Section 2 deals with the project description. We present project partners, the project goals and the different working packages. In Section 3 we report the results of our participation in this project. We summarize project results in Section 4 and discuss further development beyond project end.

II.PROJECT DESCRIPTION

Upskilling UML is carried out by a consortium composed of: Fraunhofer Institute of Experimental Software Engineering (Kaiserslautern, Germany), National College of Ireland (Dublin), Institute National Polytechnique de Toulouse (France), Softwin (Bucharest, Romania),

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[1] LEONARDO DA VINCI - Upskilling UML, Agreement n° 2005 -146 36, funded by the EC

and the New Bulgarian University (Sofia). The partners and their roles are presented below (see Table 1)

Table 1

Partner	Roles
Fraunhofer Institute for Experimental Software Engineering www.iese.fraunhofer.de	▪ Project Management ▪ Development of Learning & Training Material ▪ UML courseware in different languages, for different target groups
National College of Ireland www.ncirl.ie	▪ Blended Learning ▪ Evaluation ▪ Localization ▪ Dissemination
Institut National Polytechnique de Toulouse www.ipst.fr	▪ Learning Methodology ▪ Guidebooks for the practical application of work-based learning & training methods in several languages
Softwin SRL www.softwin.ro	▪ Courseware Evaluation ▪ Localization ▪ Dissemination
New Bulgarian University www.nbu.bg	▪ Courseware Evaluation ▪ Localization ▪ Dissemination

The goals of this project can be summarized as follows:
- development of new content and training material;
- development of syllabuses for different target groups and training concepts;
- development of innovative training concepts (e.g. distance learning with on-line tutoring, social learning, virtual learning cycles, community of practice);
- Europeanization of content, training material and training concepts including intercultural aspects;
- train-the-trainers (tutors) from different European countries;
- experimental realization of training schemes followed by evaluation.

Final users are software specialists in all kinds of industrial sectors - SME of the manufacturing (machinery and equipment) sector, logistics and communication, banking and assurances and other business activities. The needs for upskilling UML applies to the software business as a whole, and to SMEs in Europe in particular, as they are facing the threat that IT services will be off-shored for cost savings. Due to a strong demand from industrial partners all over Europe, all partner organizations have already been offering UML training courses to students and software experts, however, reaching only a small number of people through face-to-face training sessions. Examples include: UML courses for BOSCH (Germany, IESE); training courses on UML and object programming to retrain software developers and unemployed people (France, INPT), UML courses in the curriculum of the bachelor program of Computer Science (NBU). Thanks to the potential of e-learning, the speed and degree of dissemination of knowledge can be considerably increased, and with flexible learning opportunities, knowledge and skills acquisition will be facilitated. The specific aim is to create training concepts and training material in several European languages, which also means taking into account intercultural

aspects. This leads to a standardization and Europeanization of content and methodology for an important target group and industrial sector. Some innovative concepts of learning and training can be tried out and evaluated.

The project results contribute to a faster and more efficient training of a larger number of software specialists. As the trained people will be able to do their work in a much more efficient way, this would result in immediate benefit for their companies which can gain a competitive advantage. Software development and implementation will become considerably shorter which would result in visible business benefits. The introduction of work-based learning methods represents a new paradigm for most companies and also for most of the training providers. Currently a few training providers only propose something different from traditional training schemes. This pilot project intends to experience new forms of learning and training at the workplace. The software branch seems to be the ideal place for testing these new methods.

The outcomes of the project are listed below [6]:

1. **Modular learning content** for UML2 and the Unified Process (400 content objects, 118 exercises, 11 animations).
2. **Training products** in four European languages (English, French, German, and Bulgarian).
3. **Training methodology** approved by pilot tests with target group members in all five partner countries.
4. **Guidebook for practical application** of content material and training methodology.
5. **Methodological innovation**: Task-oriented approach. Requirements for blended learning.
6. **Innovation in content production**: Flexible development based on eduDocBook and the i-source Single-Source-Publishing framework. Highly modular content allowing tailoring to individual needs. Use of open source tools and international standards.
7. **Additional results**: Course Composer tool. Simulation tool. SCORM analysis and Sequencing proposal.

Several dissemination activities were also carried out**:**

1. Two project-specific **workshops**:
   - **Blended Learning – The best mix for SMEs**: This workshop addressed a more pedagogically oriented community at a major conference for Technology-enhanced learning in Europe, EC-TEL 2006[7]. The results presented at the workshop, however, had been collected from SMEs.
   - **Teach UML**: This workshop at the 3-th Balkan Conference in Informatics (BCI'2007)[8] brought together experts in teaching the specific content in industry and academia. The workshop presentations and discussions centred on the right choice of teaching mode for students and trainees from industry.
2. An **industry meeting** organised by the ProLearn network (Professional Training Facts) was used as a platform for demonstration of our technological innovation, and for presentation of project activities and outcomes.
3. The project results were presented at a number of **exhibitions** and **fairs** in all five partner countries. Examples: Learntec, Karlsruhe; International Book Fair, Frankfurt (Germany); Gaudeamus International Book and Education Fair, Bucharest (Romania).

Altogether 31 publications were produced in 26 months of project duration, among these scientific papers, experience reports, study results, presentations, and posters, that were shown at conferences, exhibitions, industrial and scientific meetings.

The work packages are presented in Table 2

Table 2

WORK PACKAGES		AIMS
WP1	Project Management	▪ Overall management of the project including quality management & risk management ▪ Monitoring of the project aims (costs, resources, deadlines) ▪ Reporting & Communication
WP2	Learning Methodology	▪ Development of new training concepts (work-based learning & training) ▪ Europeanization of content and training concepts including cultural aspects
WP3	Development of Learning & Training Material	▪ Development of new training material in close co-operation between content and educational experts and practitioners in industry and consultancy
WP4	Evaluation	▪ Enhancement of courseware and training concept through recurrent evaluation of practical application
WP5	Valorisation	▪ Set-up of training services for SMEs through close interaction between project partners and members of their target groups

For NBU the tasks as well as the corresponding working packages they belong to, are listed below:

1. Internal project management and reporting (WP1)
2. Participation in project meetings (WP1)
3. Internal report on needs analysis (WP2)
4. Feedback and validation of pedagogical design (WP2)
5. Translation & localization (WP2 and 3)
6. Feedback on design (WP3)
7. Experimental study of the beta/final version of the courseware (WP4)
8. Evaluation of courseware in industrial contexts (pilot studies, case studies) in collaboration with SMEs (WP4)
9. Regional and national marketing activities (WP5)
10. Train the Trainers for local SME and software developers from the SME (W5)
11. Set-up of a network of small and medium-sized enterprises (WP5)
12. Participation in conferences & fairs (WP5)
13. Participation in thematic monitoring activities (WP5)

The results are presented in Section 3.

III. PROJECT OUTCOMES AND RESULTS OF THE NBU TEAM

The first task of this work was to analyse the needs of software developers for UML training. To create proper training materials suitable to real-world developers, being aware of the difficulty to learn UML concepts, an investigation should be carried out. In Bulgarian SMEs the utilization of UML has been analyzed through a proper inquiry and the results were reported in [9]. The data presented in this report can be summarized to:

- UML is not properly used in the software industry;
- training is needed;
- the most important topic to be covered should be methodology;
- the training should be practically oriented;
- the learning content should be web based.

We can conclude that in Bulgaria UML is not quite used when producing software in despite of the presence of proper courses in academic curricula. So, professional training in software companies is strongly recommended.

In our opinion these results are to be used towards profiling the professional training in software companies. This training should focus on the:

- target group (companies, personnel, roles of the personnel);
- subject area (type of software projects, used methodologies);
- educational technologies (ways to supply resources, preferred methods for learning/training).

To generalize, there is a need of additional training in software development methodology and information systems as well.

The main goal of content creation within the project was to create UML courseware in four languages (English, French, German and Bulgarian), for different target groups and usage scenarios. Our team performed the translation and localization of the learning material in Bulgarian. An overview of the different versions and a content demo are presented in [10].

A Guidebook for practical application of work-based learning and training methods has been developed under the project and supervision of our french partners. This Guidebook provides instructions for teachers and trainers on how to conduct an Up2UML training, using a selection of contents from the Up2UML on-line course. The selected content can be added to other blended learning activities. Each instantiation of such training is called a scenario. Certainly, a large variety of these scenarios is possible focusing the needs of different target groups. Different learning objectives according to particular business roles or software being developed can be set. Scenarios differ also in their durations.

The content available from the Up2UML on-line course covers two parts: Unified Process (UP) and Unified Modelling Language v2 (UML). Each part pursues several pedagogical objectives that relate to one or several learning objects. Learning objects comprise: theory blocks, examples, animations and exercises. Up2UML content is a sort of learning object catalogue that can be used linearly as a whole. However, learners can get higher learning performances if the content is adapted to their needs. The scenario template introduces how these contents can be combined into a teaching/learning scenario centred on a specific business software development phase.

Summarizing the Guidebook exploits the idea to adapt training to particular target groups according to their needs that are defined by their participation in the software design process.

Following the procedure in the guidebook that allows trainers to construct a learning scenario, a set of sample scenarios have been proposed by the Up2UML partners. These scenarios are tailored for different target groups, roles and contents and can be viewed as different instances of the scenario template. Our team proposed the following scenarios:

1. Introduction to UML and UP for Software Architects

   The target group of this scenario consists of student majoring Applied Informatics at NBU. The course formats are: blended learning (a combination of face-to-face sessions with self-paced online learning) and pure online learning. The final exam is face-to-face and consists of problem solving with UML models. The participants have to show that they are able to model a small software system. The duration is eight weeks for blended learning and three weeks for online mode.

2. Introduction to UML and UP for System Analyst

The target group of this scenario consists of software practitioners from SMEs. The course format is online: a combination of on-line tutoring and self-paced online learning. The final exam is online test. The duration is three weeks. This scenario is presented in Fig.1.
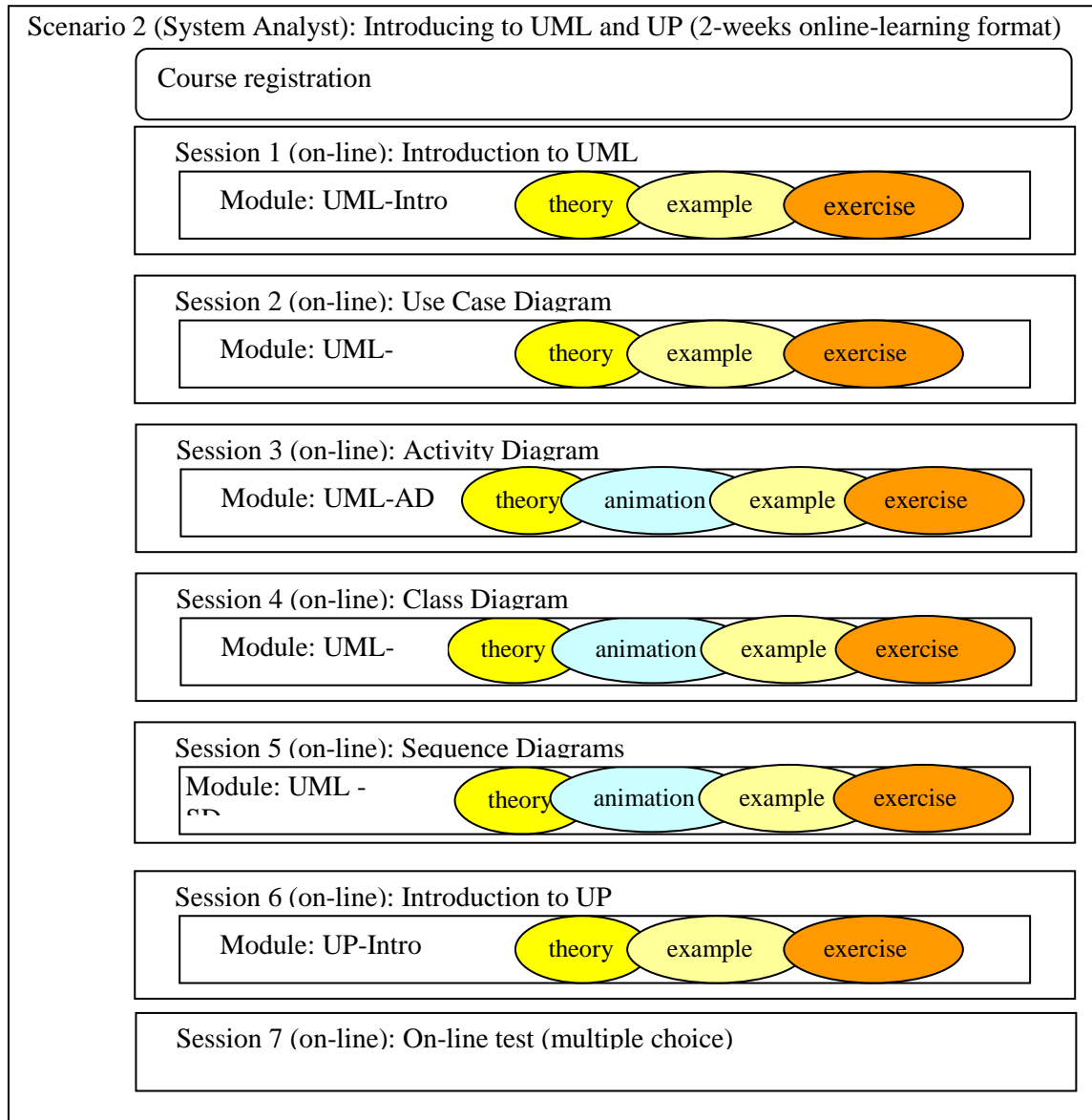

Fig.1 The scenario for system analysts

Both scenarios have been validated at NBU via pilot trainings. Pilot studies started in October 2007 and the lessons were provided via the LCMS Veda. The pilot studies were advertised as free trainings in UML on websites and on mailing lists. Participants were employees of SMEs, i.e. the main target group of the project. As one of the main goals of the project was to develop content and syllabi to be used in blended learning settings one of the pilot trainings includes a face-to-face component. In blended mode course, 59 students express interest and 32 students participated actively in face-to-face sessions. The other pilot training applies in on-line mode only (30 participants). The pilot studies comprised data collection through questionnaires, either on-line or paper-based available in long and short version. The questionnaire explored different

aspects of the learning experience, the learner satisfaction and in particular feedback in regard to the particular blend of the course. Analyses across all pilots are available at [10].

To disseminate the project results and to obtain a feedback about the usability of the learning content and the applied methodology a train-the-trainers study has been conducted. Ten lecturers and trainers from four universities and one private vocational training company were introduced to the Up2UML course and the learning methodology.

Participants were asked to rate certain aspects of the Up2UML methodology on a five point scale: strongly agree, agree, undecided, disagree, strongly disagree. Trainers found the Up2UML methodology very useful. They also perceived that this methodology provides a flexible way of creating blended learning courses. Moreover, they agree that the methodology facilitates the development of blended learning courses for a specific target group. The results are presented from the right. Summarizing participants confirmed the usefulness and flexibility of the methodology and their readiness to use it for their own trainings.
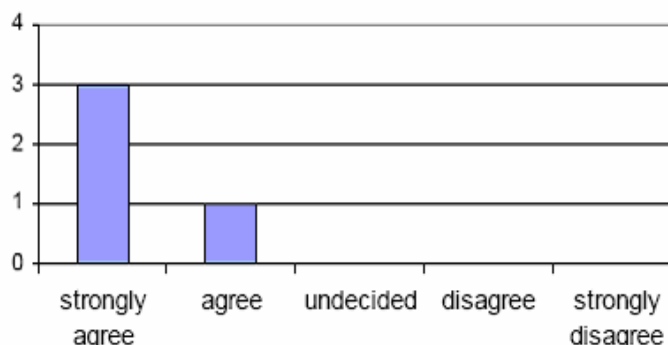
Train-the-trainers (or tutors) were also not considered as a goal per se, but as part of the pilot tests and evaluation programmes.

Overall, I find the Up2UML methodology useful.

The Up2UML methodology provides a flexible way of creating blended learning courses.

The Up2UML methodology makes it easy to create a blended learning course that suits a specific target group.

Our team took also part in several dissemination and valorization activities within the frame of Up2UML project.
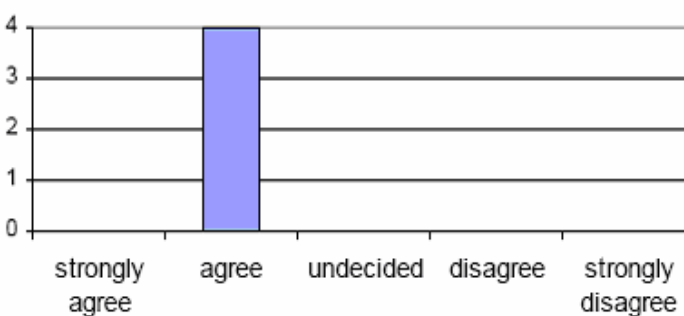The dissemination activities can be summarized as follows:
    1. Organization of proper workshop called "Teach UML" with the 3rd Balkan Conference in Informatics BCI'2007.
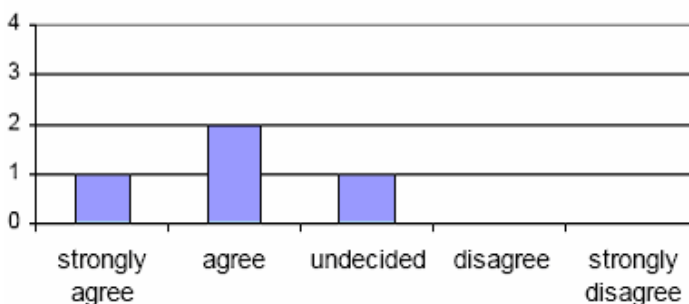
The focus of this workshop was to initiate an exchange of ideas and experiences on best practices for teaching Software Modelling, UML and object-oriented development in general. The workshop provided a forum to experts and practitioners for the presentation of best practices and the discussion of innovative approaches towards teaching the subject in academia and industry. Thirty participants most of them from academia entered a lively discussion on how to teach UML.

During the workshop, participants discussed their experience in teaching model-driven development. Interestingly, it appeared that in contrast to the multimedia hype, the use of clips and animations is seen as being not that effective and accepted as assumed. Another problem was that due to the typical layout of computer science education (i.e., programming first), model-driven development cannot be taught in isolation. Students tend to map modelling knowledge to implementation knowledge (i.e., how do I implement an association class), which requires successful training programs to provide explicit links between modelling and programming. Thus, teaching semantic is more important than simply teaching syntax. Apart from these problems, the participants agreed that following the principle of "learning by doing" or using active construction aspects worked quite well in their programs. Thus, it seems that actively using modelling (e.g., assignments, labs, etc.) together with sophisticated tools and active trainer support are key success criteria.

2. Pilot studies described above.
3. Distribution of project flyers and a special project poster.
   The project flyers proofed to be an easy and efficient way to advertise the project and disseminate project results. In Bulgaria a total of six events were attended by our team: CompSysTech '06 and '07, BCI'2007, Spring Conference of UBM 2007 and the National Seminars of E-learning '06 and '07. The target group consists of academic staff in Computer Science and IT companies. In addition to the project flyers, a poster was presented at CompSysTech '07.
4. Publications.
   The following scientific publications were produced by the project [9, 11, 12, 13, 14].

The valorisation activities performed our team focused on two groups, employees of software SMEs and trainers. In particular the latter serves as an important channel for dissemination as trainers who use the material. They could potentially reach a significantly higher number of learners than we can reach directly. The valorisation activities are:

1. Identification of users' needs - carried out the proposed by partners questionnaire.
2. Development of marketing strategy for commercialization of the projects results - advertisement in the web site of the NBU, leaflets to the prospective users in the SMEs.
3. "Train the Trainers" initiative - a tutor's network has been established.
4. Training the software developers from the SMEs with the UML courseware - two types of pilots were carried out.
5. Web-enabled deliver of the project outcomes to potential users – the course content has been translated and made available through Moodle.

IV. CONCLUSION AND FUTURE WORK

In this paper we report our participation in the Upskilling to UML - a European project funded by the European Commission under the Leonardo da Vinci program. The Up2UML deliverables will be integrated into existing training offers.

The project consortium has submitted a common project proposal ABLE under the FP7-ICT-2007-3 (Digital Libraries and Technology Enhanced Learning). The proposed project takes advantage of the existing material and methodology by making them the core element of an adaptive learning system that supports the blended learning setting in an automatic way. The

aim of this project is to develop innovative methods and technologies that help to provide more responsive and inspiring learning environments.

REFERENCES

[1] Rosenberg Marc J., Redefining E-Learning, The Batten Institute at the Darden Graduate School of Business Administration, http://www.darden.edu/batten ,(2002).

[2] http://www.omg.org/cgi-bin/doc?formal/05-07-04

[3] Ambler S. The Object Primer: Agile Model Driven Development with UML 2, 3-th ed, Cambridge University Press, (2004)

[4] Kobryn C.: UML 3.0 and the Future of Modelling. Software System Modelling. Springer-Verlag. http://www.kobryn.com/docs/papers/SoSym_Mar04_p4_Kobryn.pdf ,(2004).

[5] www.nbu.bg/curricula

[6] www.up2uml.org

[7] www.ectel06.org

[8] http://bci2007.uni-sofia.bg

[9] Peneva J., Ivanov S., Tuparov G. Utilization of UML in Bulgarian SME – Possible Training Strategies, in Communication and Cognition-Artificial Intelligence Vol. 23, N° 1-4, pp.83-88, (2007).

[10] UML Courseware, Final Version in different languages and for different target groups, http://up2uml.iese.de/demo

[11] Ivanov, S. & Peneva, J. Tailoring the computer science courses for distance learning, in Mathematics and Education in Mathematics, pp. 363-368, ISBN 978-954-8880-25-1, (2007).

[12] Tuparov G., Peneva, J., Asenova, P., Ivanov, S. Upskilling to Object-oriented Software Development with the UML , Proc. of the International Conference on Computer Systems and Technologies (CompSysTech'07), Rousse, (2007).

[13] Tuparov G., Ivanov S., Peneva J.,Assenova P. UML Skills for Software Development in Bulgarian SME, Proc. of the 2nd International Workshop on "Computer Science and Education in Computer Science", Borovetz-Sofia, pp. 37-47, ISBN–10: 954-535-430 (2006).

[14] Ivanov, S., Peneva, J. Restricted Self-Directed Learning – a Proper Use of Distance Education, Proc. of 2nd National Conference of e-Learning in Higher Education pp. 54-57, ISBN-10 954-07-2413-9, (2006).