

Design of an eLearning System for Accreditation of Non-formal Learning

Eugenia Kovatcheva, *epk@fmi.uni-sofia.bg*
University of Sofia, Faculty of Mathematics and Informatics

Roumen Nikolov *roumen@fmi.uni-sofia.bg*
Sofia University, Faculty of Mathematics and Informatics

Abstract

This paper deals with issues related to the non-formal learning in vocational education, and the role of ICT for providing appropriate accreditation model in such education. The presented conclusions are based on the Leonardo da Vinci project LeoSPAN. The paper emphasises on the development of a model and a prototype of an adaptive eLearning system that ensures the pre-defined learner outcomes. One of the advantages of the eLearning system is the flexibility for people who upgrade and improve their knowledge.

Keywords

non-formal learning, e-learning, evaluation, item response theory, computer adaptive testing

INTRODUCTION

The school is no longer the sole and the most attractive source of information and knowledge. Quick access to unlimited sources of information is widely available due to modern technologies. The traditional concept of literacy has been gradually extended to a *multimedia literacy* referring to students' abilities to read, write, and communicate with digitally encoded materials - text, graphics, still and moving images, animation, sounds (Nikolov, 1997). The way the people learn is changed as well. The existence of non-formal learning that is not provided by an education or training institution has been widely recognised. This type of learning does not typically lead to an official certification. The development of an analytical model that depicts the links between non-formal learning and the recording and certification of non-formal competencies is among the main goals of the Leonardo da Vinci project LeoSPAN. The project aims to develop a multi-level model based on trans-national experience. The public attractiveness of the non-formal vocational training is determined by the opportunity for a short period of time the learners to acquire the relevant document (certificate, letter certificatory) necessary for receiving a job position (in the country or abroad) and also for starting their own business. The study has been carried out as a partner contribution on the analyses of the non-formal vocational training (VT) for low skilled people in the participating countries-participants in the LeoSPAN project. In addition, an adaptive model and a prototype of a system for self-evaluation based on e-learning standards have been developed.

The first section in this paper describes the project LeoSPAN and the main conclusions drawn from it. The goal of the second section is to highlight the most important factors in the ICT driven educational reform. The third section presents a model and a prototype of an adaptive eLearning system supporting the VT.

PROJECT LEOSPAN BACKGROUND

Vocational training is a **socially significant phenomenon**. For Bulgaria it appears to be an essential factor for raising the competitiveness of the national economy in the context of the Bulgarian EU membership. The non-formal vocational training is an example of a **good social model** for personal development of the citizens. In year 2006 the Ministry of Labour and Social Policy launched programmes with a total budget of 11,5 million BGN for literacy courses, vocational training and qualification. As a result more than 40,000 low skilled people (predominantly gypsies) received the opportunity to overcome the unfavourable conditions they have been experiencing for many years.

The methodology for carrying out the study is based on interviews with representatives of the main stakeholders in the VT process. The target group consists of:

- Low skilled workers/unemployed who have passed certain VT course;
- Employers;
- Managers of VT centres and trainers;
- Experts responsible for vocational education and training policy.

The project objectives predetermine the category of the low skilled people to be addressed as they have been intimidated by long lasting unemployment or serious difficulties to find appropriate job. That is why the efforts were concentrated on this group of people who are attending courses giving first level of qualification.

In parallel with the interviews a desktop content analysis on current vocational training documentation has been done. For instance - the documents related to the National Qualification of Professions and Positions (NQPP) have been analysed in depth.

The study aims to gather information for the current status of the non-formal VT in Bulgaria. It does not have a representative value because of the small number of the interviews carried out. The study **is focused on the development of a general view on the VT** in the segment "low skilled people" which is the most sensitive from a social point of view. The results of the study are used as specific indicators for comparison with the relevant findings of the other project partners. The identified weaknesses could be used for formulating measures for improvement of the VT system in Bulgaria especially considering the recent EU membership of the country.

The **main tasks of the study** are:

- to develop and adopt a concept for carrying out interviews with the basic stakeholders of the vocational training: workers/unemployed people, employers, heads of VT Centres, trainers and experts, responsible for vocational education and training policy;
to define selection criteria and the target groups for carrying out the interviews;
- to organise and carry out 15 interviews with the selected participants from the target groups;
- to summarise and analyse the information gathered by the interviews and the selected documents;

The LeoSPAN **research methodology** is based on comparative multilevel case studies. On the micro level the focus is on the support activity of the responsible practitioners who are targets of the activity. The activity is conditioned (on the macro level), on one hand, by the local, political, economical and educational governance

and negotiation patterns. On the other hand, it is directly or through local mediation conditioned by the national policy and decision-making processes.

The challenge of the project is to carry out the research in such a way, that the pattern of accreditation and support systems becomes visible and the development of “educationally correct“ quality criteria and recommendations for improvement to be based on substantial cross-cultural evidence.

Some of the design principles of the study are:

- the screening and the comparison of the reference material of each country is made on two levels: macro level (governance) and micro level (practitioner);
- the connection between macro and micro level is established by relating the comparative criteria on both levels, e.g. what are the institutional objectives (macro level) and how are they realised (micro level);
- the interdependence between the comparative criteria on both levels is supposed to be transparent;
- the specification of research objects (institutions) and the target groups (practitioners) could follow the national and/or regional patterns. However the SMEs and low skilled workers should be addressed primarily;
- The conducted research consists of four steps: data collection, analysis, comparison and critical reflection;
- Two methods of description are used, namely:
 - **criterion-based description**, i.e. the accreditation, certification and support systems are described according to the comparative criteria referring to the **macro level**.
 - **Empirical description**: support systems are described by means of structured interviews on the **micro level**.

MAIN OUTCOMES OF THE LEOSPAN SURVEY

The analysis made shows that Bulgaria has relatively well established and functioning system for non-formal vocational training. Some more comprehensive analysis and reports for different target groups have been developed. The main conclusions are given below:

- **„Low skilled people/workers“**: The basic reason for attending VT course is the **opportunity to find appropriate job**. According to this they define their aim – to receive a certificate for acquired professional qualification.
- **Employers**: The non-formal VT is defined as **necessary** for the activities of the company and for increasing its human resource capacity. In the same time, the non-formal VT is not identified as being among the most urgent priorities for the moment of the interviewed employers.
- **Heads of VT Centres and Trainers of Low Skilled People**: Both participating centres are legal entities, licensed by the National Agency for Vocational Education and Training (NAVET). The centres are self-sustained organisations. A part of their budget is provided by the state by subsidising training services. Another part of the budget is project based and it is ensured by participating in competitive calls for proposals. The third part is based on providing paid training services to companies and other organisations.
- **Experts, responsible for the VT policy**: The survey results show that the non-formal VT is included in the scope of influence of the relevant state documents, such as: “Act on Vocational Education and Training”; “Framework Programme “E” of Ministry of Education and Science”; “Act on Employment Encouragement”; “Strategy for Life-long Learning”, etc. These documents provide some evidence

that there is an existing **practice of certifying the non-formal education**. However, there are identified certain difficulties, such as the lack of mechanisms for equalisation of the acquired general knowledge and skills to the relevant degree of the basic or secondary education.

A deeper analysis for the case of the VT centres has been made. It shows that:

- the VT Centres are well functioning and are able to cover the necessities of non-formal vocational training for the first qualification level of all professions that are included in the NQPP;
- the centres have at their disposal also premises, equipment and teaching materials for practical trainings.
- the trainers have the necessary ground and the managers – the relevant experience and skills, for organising and carrying out the training process;
- after finishing the courses **the trainees take examinations** and appropriate certificates are issued for those who have successfully passed them;
- the training is financed basically by the state budget and European programmes and projects. The percentage of the courses paid by the employers or by the trainees themselves is relatively low;
- the **training as a whole is not conformable** (as type and number) to the free job positions. The basic reason for this is the lack of mechanisms for interrelation with the small and medium sized enterprises (SMEs). Nowadays the SMEs present practically 98% of all enterprises in the country and almost half of the workers are employed in them. In the same time SMEs have no presentation in the branch organisations and practically do not participate in the process of vocational training and qualification.
- **a key factor** for improving the level of non-formal education in Bulgaria is its modernisation in several directions:
 - **initiation of a system** for studying the employers' needs of vocational training for their personnel;
 - improvement and further development of **standards** for level of professional qualification including opportunities for validation and certification of the non-formal vocational training;
 - **modernisation of the teaching equipment** allowing anticipated training (using contemporary technologies);
 - **counselling and consulting** of low skilled people organised by the employment bureaus when choosing certain vocational training.

The conclusions made do confirm the needs of vocational education and training. All spending in education and training is considered as an investment in human capital, and vice versa - any investment in human capital always imply spending for education and training. Investments in integrating ICT in education and training are considered as being of crucial importance for improving the quality of education. However such investments should be dedicated to educational projects which are based on a solid knowledge both in learning theories and technologies.

ICT DRIVEN EDUCATIONAL REFORM

We are witnessing an ICT driven educational reform now, which could be expected to take much less time than the one based on printing technology. The current educational reform is based on three major factors - asynchronous space and time, responsive environments, and virtual reconstruction that can “powerfully transform the way schools work” (McClintock, 1992, p. 52):

- **asynchronous space and time** is the ability of people, who are not synchronized in the same place at the same time, to communicate easily with each other in a variety of responsive ways;
- **responsive environments** are customized to the learners' needs interactive learning environments which will help them better learn and communicate;
- **virtual reconstruction** is the ability to use interactive multimedia components to redesign and reconfigure the human experience of existing physical spaces without having to make physical, structural changes in buildings. The virtual spaces could complement the physical spaces by designing an effective and student centred learning environment.

According to McClintock:

- the new role of the school is to guide students how to learn by themselves;
- learning is defined as an active process;
- interaction in class is considered as a way students to overcome the information overload with the help of teachers and their schoolmates.
- teachers and learners are given much more freedom, but their responsibility is increased.

AN ADAPTIVE E-LEARNING SYSTEM

Having in mind the characteristics of the non-formal learning, as well as the requirements of the ICT driven educational reform, a prototype of an Adaptive e-Learning System (AeLS) has been developed. One of the main features of AeLS is to support the accreditation process in VT. The personalized support of learners has been identified as among the most important functions of the system since the learning takes place in an open and dynamic learning environment.

A **model of an adaptive eLearning system** that ensures the achievement of pre-defined educational outcomes has been developed. In the case of VT the system has to support adaptive assessment, i.e. to adapt the tests to the learners' ability (knowledge and achievements). The proposed model is based on the Item Response Theory (IRT) and the Computer Adaptive Test (CAT) methodology. For the purposes of learners' oriented adaptation of the tests the model uses the IRT three parametric model which takes into account the difficulty, discrimination and pseudo-guessing in the testing process(Baker, 2001).

The AeLS model includes the described below basic modules and the links between them (Salgueiro, et.al, 2005, Boytcheva. & Kovatcheva, 2005):

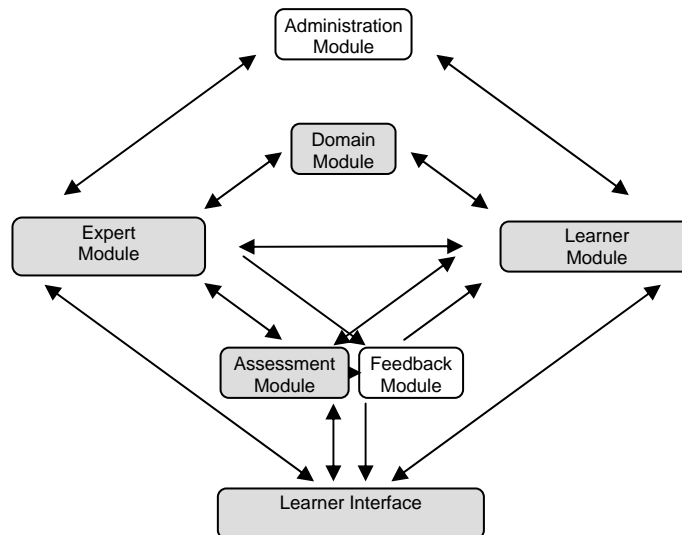


Figure 1: A Model of an Adaptive eLearning System

- **Administration module** – maintains the administrative part of education
- **Domain module** - navigates the user through the learning process, e.g. through the Planning Agent, Curriculum, Dialog System, knowledge of the subject formed by the production rules, etc.;
- **Expert module** – it is related to the teaching strategies. The expert module includes a domain knowledge base that provides the structural description of the subject area, represented as learning objects, concepts and relations between them represented as domain ontology. Learning Objects (LO) are chunks of elementary knowledge in the domain (Table 1). In this system the expert module could be human (teacher / trainer) as well as a mentoring engine;
- **Learner module** provides individual characteristics of the student, e.g. how much the learner knows about the domain. It contains also a list of facts describing the history of the user interaction and performance at every step;
- **Assessment module** - the domain knowledge base provides the structural description of the computer adaptive test (as in the expert module).. The metadata for any item could be separate in to types (Ibraheem et al, 2003): descriptive and psychometric (see Table 1).
- **Feedback module** – it generates and provides the proper feedback to the learner;
- **Learner Interface** deals with the challenges of computer-user interactions.

Learning Objects metadata	Item metadata
Objectives <ul style="list-style-type: none"> ○ aims ○ knowledge Content <ul style="list-style-type: none"> ○ declarative type: text, video, audio, ... ○ procedure type: tasks, examples, exercises Assessment <ul style="list-style-type: none"> ○ test, questionnaires, tasks, exercises ○ evaluation criteria ○ Test Aspects ID number	Descriptive metadata Objectives <ul style="list-style-type: none"> ○ aims ○ knowledge Characteristic <ul style="list-style-type: none"> ○ type: yes/no, multiple choice, ... ○ allowed time ○ number of attempts ○ difficulty level ○ item answer ○ item mark ID number Authorship Creation Date

Authorship Creation Date	Psychometric Metadata <ul style="list-style-type: none"> ○ difficulty parameter ○ discrimination parameter ○ guess parameter
---	--

Table 1: LO & Item metadata

The common metadata for LO and Items (Table 1) are the relations between the LO pool and the Item Bank. In the LO metadata is described the assessment task. The opposite congruence is complicated because a LO can be used in more than one topic. In this case a question about it does not necessary lead to one specific topic. This problem could be solved by using some methods related to Artificial Intelligence. The main feature of the assessment module (see fig. 1) is to keep the track of each test in collaboration with the learner's model. In order to identify the learner achievements in the defined topics several intersections should be made by including the items with lower students' achievements. One of the most successful approaches for supporting this process is using the intelligent agents technology (Russell & Norvig, 1995). The procedure should identify the exact topics where the learner has demonstrated lower achievements.

The next phase is to provide some appropriate content to learners. After identification of the topics with problems the system re-directs the learner to the problematic topics and composes content according the student ability level (low, medium, high).

A **model prototype** is developed as an extension of the learning management system ARCADE developed at the Department of Information Technology, Sofia University (Bontchev & Iliev, 2003). As a result a CAT for assessment module and an item bank have been integrated into the ARCADE system (see fig. 2).

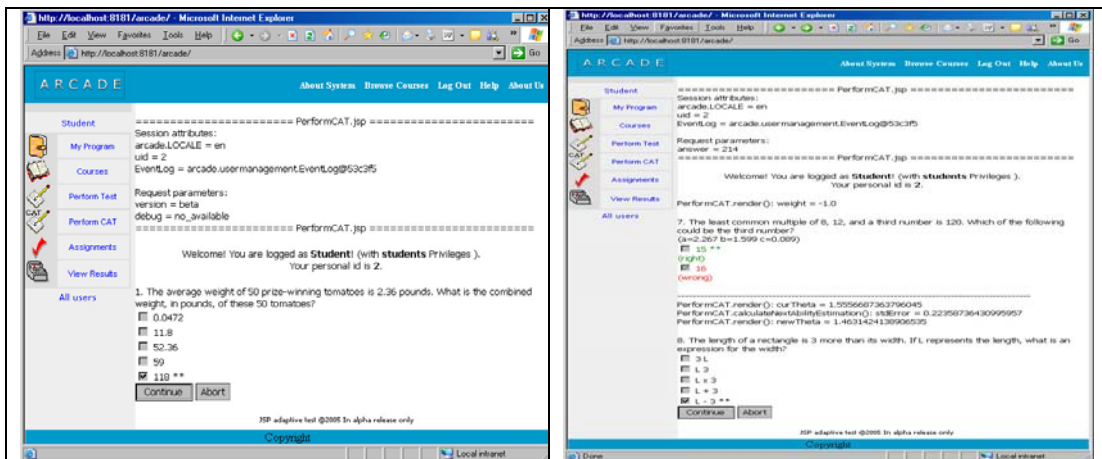


Figure 2. Screen shots from the AeLS

The main difficulties in developing the AeLS were related to filling in the item bank, i.e. creation of adequate well described questions. Each item has to be constructed, validated and then - published by using appropriate metadata. This process is very complicated and it needs a lot of time and efforts of many stakeholders.

CONCLUSION

The ICT based education tends to be mostly related to designing and using virtual learning environments. A very important role in effective use of learning environment

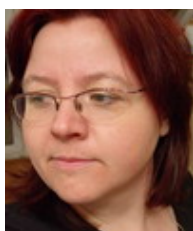
plays the instructional designers who should apply some appropriate learning theories when defining the learning activities.

The main advantage of AeLS is flexibility which makes possible adaptation of learning to the individual needs and preferred learning modes. This feature is very important for non-formal education and vocational education and training.

REFERENCES

- Baker, F. (2001) *The Basics of Item Response Theory*, ERIC Clearing house on Assessment and Evaluation
- Bontchev, B., Iliev, T. (2003) *ARCADE - a Web-based Authoring and Delivery Platform for Distance Education*, 1st Balkan Conference on Informatics (BCI'2003), Thessaloniki, Greece, 21-23 November.
- Boycheva, S., Kovatcheva, E., (2005) *Development of Adaptive e-Learning System Based on Learning Objects*, In Proceedings, International Conference on E-learning, 6-7 Sept, 2005, Berlin, Germany. pp. 245-254
- Eraut, M. (2004) *Informal learning in the workplace*, Studies in Continuing Education, Vol. 26, No. 2, July 2004, pp 247-273
- Ibraheem, A. M. Shaalan, K., Riad, M. B., and Darwish, M. G. (2003) *A Model and Supporting Mechanism for Item Evaluation in Distance Learning-Based Environment*, Egyptian Information Journal, Vol.4, No 2, December 2003, pp 169-186.
- McClintock, R. (1992), *Power and Pedagogy: Transforming Education through Information Technology*, Institute of Learning Technologies, New York
- Nikolov, R. (1997). *Distance Education via Internet – Education without Borders*, invited paper, Proceedings of the Twenty Sixth Spring Conference of Bulgarian Mathematicians, Plovdiv, 22-25 April, pp. 53-66
- Russell, S. J. and Norvig, P. (1995) *Artificial Intelligence: A Modern Approach*, 1995, Prentice Hall, Englewood Cliffs, New Jersey 07632
- Salgueiro, F., Costa, G., Cataldi, Z. Lage, F. Martínez, R.G. (2005) *Redefinition of Basic Modules of an Intelligent Tutoring System: The Tutor Module*, Proceedings VII Workshop Argentine Computer Science Researchers. pp. 444-448, 2005

Biography



Eugenia Kovatcheva is chief assistant prof. at the dept. of Information Technologies. She works in area of Telematics Application in Education & Training, Multimedia and Hypermedia, Development of Internet Applications. She is member of the editorial board of Int. J. of Web Based Communities (IJWBC). She has participated in more than 10 EC projects. She has specialized in Japan, The Netherlands, and France.



Assoc.Prof. Roumen Nikolov is head of dept. of Software Engineering. He works in the area of e-Learning, e-Government, e-Commerce, e-Work, Multimedia and Hypermedia Systems, Management Information Systems. He has been an IST NCP for the EC 5FP and FP6 and involved in more than 20 projects from 4FP, 5FP and FP6, such as FP6 GUIDE, Kaleidoscope. Dr. Nikolov has more than 50 research papers and presentations and has specialised in UK, the Netherlands, and other EC