Virtual Learning Environments: Towards New Generation

George Totkov

Abstract: The classification of the virtual education environments (VLE) is based on the functional characteristics, inherent (or not) of the respective environment. In their evolution history there are three distinctive generations of VLEs. Numerous are the examples of platforms displaying characteristics of 1st or 2nd generation systems, still, examples of 3rd generation VLEs are a matter of conditionality. At best we can talk only of 2.5 generation systems. There is not an unambiguous answer of the question what the components of a 3rd generation virtual education environment are. The paper is an attempt to answer this question.

In our view, the three more distinguishing trends in the development of VLE are the resort to cognitive methods, integration with other systems (for management, planning, etc.) and the changes under the influence of new technologies.

Key words: *Distance Education, Virtual Learning Environments.*

1. INTRODUCTION

At the Lisbon Summit of European Council on 23 and 24 March 2000, the Heads of State and Government set to the Union the objective of becoming "the most competitive and dynamic knowledge-driven economy in the world". Europe which, enjoys one of the highest levels of education, and has the necessary investment capacity, still lags far behind in the use of the new information and communication technologies (ICT).

One of the key ways in which both distance and campus-based learners can be provided with more appropriate and flexible teaching material is through the use of virtual learning environments (VLE). These provide an environment in which study can take place with suitable material being provided, and interaction with staff and other students also being available. We witness the generation of the first VLEs and environments of the type *virtual university* [1, 6, 8, 17, 18, 24]. The modern virtual universities provide easily-accessible, user-friendly interface, different methods for on-line access to the necessary resources and services as well as communication between the agents in various media (text, audio and video).

The first researches in the field of Virtual University Environments (VLE) in Bulgaria were carried out in the Sofia University [12, 16] – the *ARCADE* system, the Plovdiv University [14, 15, 21] – *PeU* and the Rousse University – the *eLSe* system [7].

2. EVOLUTION OF DISTANCE EDUCATION

The dynamic progress of the ICT was one of the driving forces behind the design of open education related with new approaches to the organization, the implementation and the management of the education. The open learning takes different forms: flexible, resource-based, distance, etc.

Over the past century, distance education (DE) passed through several generations. Six stages in the development of DE might be distinguished conditionally – initial stage (1840-1900), 1st stage (1901-1940), 2nd stage (1941-1980), 3rd stage (1981- 1990), 4th stage (1991-2000) and contemporary stage (from 2001).

Initial Stage (1840-1900)

In the mid- to late 1800's, *correspondence or home study* became a legitimate form of education with the development of inexpensive postal services in Europe and across the United States. Instructors used to send readings, study guides, and other print materials by mail to students who gained credit for successfully completing specified assignments. In 1840 Isaac Pitman utilized the new postal services to provide a correspondence course, which was in fact the first distance education programme. In 1836 the London University

was established, different educational degrees were granted to the students and starting from 1858 foreign students was given the right to obtain degrees as well.

1st Stage (1901-1940)

On this stage *radio programmes* were vastly used in education in addition to the organizing and implementation of correspondence courses. In the decades 20es and the 30es of the past century numerous were the researchers to come to the idea of programmed education[1] and identification of the education process by means of working out the first programmed lessons.

2nd Stage (1941-1980)

In the late 1960's and early 1970's, teachers began to experiment with the use of radios, TV sets, audiotapes and telephones in combination with study guides and local library resources to provide educational opportunities for students who were separated from instructors by geographic distance. The particularity of the *TV programmes* as educational tool was misunderstood at the very beginning. That is the reason why the success of TV programmes was limited and discouraging – the educational courses were not of very good quality, their emission was in unbecoming hours, the consumers' feedback was lacking. The earlier developments in the field of the computerised education were carried out in the State University of Florida, the Dorstmun University and Stanford University. The first *learning programme*, created by Anderson, Brenar and Roth in the Pennsylvania University in 1958, was for binary arithmetic.

3rd Stage (1981-1990)

Advancement in interactive and digital technologies forms the basis for the third generation of DE. On that stage educators were delivering instruction to students in remote locations via *interactive television, electronic networks, and computer-based multimedia systems*. The primary difference between second and third generation DE is that third generation DE allows teachers and students to send and receive synchronous (real-time) and asynchronous (delayed) audio, video, text, and graphics. Rapid advances in ICT associated with what may be called an electronics revolution of the 1980s made it possible for the first time in history to teach face-to-face at a distance. By electronically linking students and teacher at various locations by cable, microwave, satellite television it becomes possible to create a virtual classroom.

The mass spreading expansion using of *personal computers* (PC) is dated from that period. Good examples of computer-assisted education, computer-managed education and computer-based learning materials came to existence; experiments of global emissions of seminars and educational courses, simultaneous emission of video-imaging, voice and data, etc., were carried out.

4th Stage (1991-2000)

Local Area Networks and Wide Area Networks link the PCs and the communication systems and enhance the on-line access to information and distance training of one's abilities. It seems that the importance of books as a basic source of information gradually tends to diminish and their role in education is being taken away by computers, radio, television, etc.

The rapid development of the *Internet* in the years 1995 – 1999 created a new global dimension for e-learning, as individuals all over the world study for degrees or other qualifications from their computer screens either at home or at work.

In the period 1995 to 2000 the whole world was going mobile, as mobile telephones and mobile computers allowed individual students anywhere to follow their courses and communicate with the university while travelling.

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[1] Segmentation of the learning material in small, logically coherent portions of information, the acquiring of the information is accompanied by questions and/or problems and immediate explanation of the answers.

Contemporary Stage (from 2001)

The beginning of the period is marked by the *institutionalization of DE* and *the electronic learning* (e-learning) in Europe and in our country. General availability of voice synthesis, voice recognition and voice input into telephones and computers, whether fixed or mobile seems to be the distinctive characteristic of the period. There should again be benefits for distance systems rather than on campus, because of the greater reliance of distance students on correspondence, assignment preparation, and assignment submission.

By 2000 wired telephones and wired computers were beginning to be replaced by *wireless* ones. This has important didactic dimensions as it frees the learner, who may have spent much of his or her working day in front of a wired computer, from studying in front of a computer screen too. Although there is much evidence from e-Learning research of the interactive value of emailing, the validity of typed interactions for learning purposes can be questioned when compared with spoken interaction.

3. EVOLUTION OF E-LEARNING ENVIRONMENTS

Mason [10] suggests that there are ***three basic models*** of existing ***on-line courses***:

- *Content + Support model* (web-based materials provide the content of the course, supplemented by tutorial support; the level of on-line interaction is low and the model is very akin to traditional teaching with the content being delivered via the VLE, rather than by a teacher; this is probably the most common model at present;
- *Wrap-around model* (here course materials are accompanied by activities and on-line discussion etc. with a consequent increase in the time spent on-line);
- *Integrated model* (this is a resource-based model where the course is based on collaborative activities, discussions and joint assignments; the course contents are dynamic and influenced by individual needs and group activities, with resources being contributed by students or tutors as the course develops.

Electronic Learning (e-Learning) is a contemporary form of DE that enhances teachers and students to communicate by the intermediary of synchronous and asynchronous audio, video, text, and/or graphics in a hypermedia environment. Its immediate predecessor, computer mediated communications, relied primarily on e-mail and asynchronous text-based communications to promote learning. E-learning differs from the 3rd generation DE systems in its using of the World Wide Web (WWW) and related TCP/IP based telecommunication tools (e.g. electronic bulletin board system, chat, e-mail) as primary and secondary means for communications.

While recognising that the world at large will continue to use terminology in different and often ambiguous ways, some authors recommend that the term *Virtual Learning Environment* (VLE) be used to refer to the components in which learners and tutors participate in "on-line" interactions of various kinds, including on-line learning.

The classification of the VLEs is based on the functional characteristics, inherent (or not) of the respective environment. In their evolvement three generations of VLEs can be discerned [13].

The *1st generation VLEs* includes Web interface (for students and for instructor) and integration of facilities – learning content editor, HTML pages, test system, discussion forum, assignments delivery system, e-mail, etc. The course is organized as self-teaching with *animation* (picture, hyperlinks, etc.), *interaction* (case examples, self tests, e-mail, etc.), *team collaboration* (virtual classes, discussions), etc.

The *2nd generation VLEs* consists of a content management system based on Database (DB) of learning materials from the one side and an e-learning platform/frame in which the learning process is structured and the activities and the learning materials are linked via their URL.

The main features of the *3rd generation VLEs* are:

- *interchange ability of learning materials (for example, using standard document format XML);*
- *intelligent document search (customized learning);*
- *dynamic personalized learning path (learning path based on the learning objectives and no longer on a content structure);*
- *blended learning with integration of a life session;*
- *integration of application of business simulation, etc.*

The *advanced e-learning systems* have:

- *browser based interface for efficient document/info transfer;*
- *a DB of learning documents;*
- *a powerful search facility;*
- *a flexible DB connection allowing linkages with the management information system (students, courses and instructors id data);*
- *tools for easy adaptation to different learning applications;*
- *(XML) authoring tools for the development and adaptation of e-learning materials, etc.*

4. FORWARDS NEXT GENERATION OF VLE

Numerous are the examples of VLEs displaying characteristics of 1st or 2nd generation systems, still, examples of 3rd generation are a matter of conditionality. At best *we can talk only of 2.5 generation systems*. Despite the springing of several clear-cut trends (and even some exotic ones) in the development of VLEs, the determining characteristics of the next generation are hard to predict unambiguously.

In that respect, satisfactory answering of the *questions* – what the future VLEs will look like; what kind of new ideas and technologies will be utilized in the base of their working out; whether it is possible to preview their basic functional characteristics and elements; what kind of novel means of education, learning, support, communication and management the agents of the education (authors, lecturers, students, tutors) will provide, is of primordial importance.

We cannot possibly engage to give the precise answers and prognostications in the limited space of the present work. On the other hand, we believe that there is an acute need to provoke and hold a discussion in order to promote and focus the research in the field of e-learning in Bulgaria. Looking from that angle, the present contribution can be considered to be an essay to promulgate such kind of debate.

In our view, the three more distinguishing trends in the development of VLE are the resort to *cognitive methods*, *integration* with other systems (for management, planning, etc.) and the changes under the *influence of new techn*ologies. The following examples support this thesis.

Trend 1. Integrated (Hybrid) VLE

Example 1.A. Internet and Satellite Television

A brand new trend in the development in the field of the VLE is the integration of the Internet and the satellite television for the provision of audio-visual and multimedia learning materials. *Mosaico* [11] with its 5000 subjects in 10 domains is a revealing example for such kind of environment**.**

Example 1.B. Managed Learning Environments

Managed Learning Environments (MLE) are software applications that support on-line learning. They often include VLE that supports all the educational activity associated with the learning experience. In this respect MLEs offer functions to support pedagogy, the management of learning materials, student administration and communications. MLEs have the potential to unify, monitor and co-ordinate all activity within universities, and

critically in respect of the promised national network for further education and the University for Industry, to link activity between institutions.

It is recommended [9] that the term *Managed Learning Environment* is used to include the whole range of information systems and processes of the University (including its VLE if it has one) that contribute directly or indirectly to learning and learning management. Universities that already have a VLE installed should ensure that it meets the needs for student tracking and can be integrated with existing Management Information Systems, using the e-learning standards.

A typical tool for the Management of Learning [19] is to allow:

- *on-line interaction between student and tutor to allow the negotiation and creation of study programmes;*
- *the management, categorisation, browsing and searching of computer based learning resources;*
- *the creation of individualised learning programmes from these resources;*
- *the creation of student profiles consisting of grades, comments and suggestions based on students' use of resources and other learning activities;*
- *the sorting, searching and querying of these profiles to allow the creation of further study programmes;*
- *undergraduates to access and use new technological tools as an integral part of the process of learning.*

Trend 2. Cognitive VLEs

Example 2.A. Project *Cognitivity*

An example of VLE with cognitive elements is the flexible, intelligent learning software tool *Cognitivity* [2] developed to meet corporate training needs and to work with the latest e-learning standards. *Cognitivity*'s learning engine consists of both a Course Management System, used to serve courses, and a Learning Management System, used to track students as they progress in the system. *Cognitivity* has been engineered to support:

- *management not only of courses, but of supporting "non-course" content, including corporate documents, Q&A forums, customized "knowledge bases", and input by subject matter experts;*
- *integration of online self-study, live classroom meetings and virtual training methods, within a single course, as needed to best meet a particular training goal;*
- *"agent" technologies that can present dynamically generated, customized training content based on the learner's past performance, job description, chosen preferences, or any other criteria;*
- *full support within any course for discussions between learners and course administrators, subject matter experts, or between learners themselves;*
- *sophisticated tracking & analysis tools to provide trainers with extraordinary tools for assisting learners and improving training materials;*
- *"classroom" paradigms to allow learners to be grouped into logical categories, managed as a set, or interact among themselves;*
- *management of both live and e-learning based training within the same system, using the same tools;*
- *support for IMS/AICC/SCORM standards, for interoperability with other compliant e-learning tools and platforms, etc.*

Very interesting concept in this engine is the so called *Reusable Learning Object*[1] (RLO). Using RLOs, multiple courses can be created using the same "library" of components. Reusable Learning Objects are small "blocks" of course content that may be

[1] Note, the same concept is used in PeU [14,15].

used, and reused, in many different courses. RLO may be edited at any time; these changes will propagate, automatically, to any courses in which the RLO is used. Any objects (including images, video, audio, linked documents, subsections, quizzes and exams, individual quiz questions and feedback, or even individual paragraphs or sentences anywhere within the course) may be made into RLOs, not just "chapters" or "sections" of a course. Each individual course may be assembled using a collection of these Learning Objects. Reusable simply refers to the ability to use the same object in more than one course. RLOs can simplify course development and streamline course maintenance.

Cognitivity allows not only sections of a course but any related documents or other resources to be packaged as RLOs, and allows each visit to those resources to be tracked and reported. A course can also link to other courses that might present more information about a certain topic; the learner could even be automatically enrolled in any of those courses that they wished to visit, or might be able to access them only upon enrolling in some other manner.

Other *Cognitivity*'s capabilities are:

- *reusable Learning Object creation and course assembly, including the ability to assemble a course using any combination of pre-made and new content;*
- *ability to define custom templates for all aspects of course look & feel, and to change those templates for individual courses or groups of courses;*
- *simple quiz and exam creation, including options for randomized question selection and customized feedback;*
- *access to the complete capabilities of HTML, or the ability to limit the use of undesired HTML features;*
- *ability to present the same course with multiple look and feels based on department, vendor, student preferences, or other criteria;*
- *ability to link courses to a "knowledge base" of related documents and resources.*

Example 2.B. Linguistic VLE[1]

It is beyond any doubt that the computer-man interaction in the Information society will be based on the cognitive technologies and methods including the natural language processing.

Recently, the first attempts for the creation of prototypes of *VLE with linguistic components* have been made in the world practice. These systems are still in their embryonic state and there is a perceived deficit of deep scientific researches in that direction. One of the aims the present work is targeting at is stimulating the formation of a new scientific area in Bulgaria, namely the exploration of such VLEs**,** especially oriented for implementation in the Bulgarian educational system. A project for designing VLE with linguistic components (related with the Bulgarian language and speech) is proposed. Specific possibilities of this system will be:

- *cross-lingual information retrieval of learning Internet materials written in one language (when there is a lack of materials) with queries written in another;*
- *assessment of open questions by means of automated problem solvers for them;*
- *automatic clustering of learning materials after the concepts and relations have been extracted from them;*
- *transformation of text to speech, etc.*

The premise for achieving the set goal is the successful work of many Bulgarian researchers in two scientific domains – computational linguistics (the purposely created lexical resources and software tools for the processing of Bulgarian text [20, 22, 23]) and VLEs (the proposed methodologies and the prototypes of VLEs worked out).

[1] The work was supported by the Plovdiv University Grant M-30/2003 "Linguistic Modeling in VLE".

In the context of the advanced work over the creation of the commercial analogue of the system *PeU*[1], we expect the main problem for its successful realization to reside in the devising of separate linguistic components and their integration in an integrated VLE.

The methods, tools and resources for processing Bulgarian texts and speech, developed in the frame of the proposed trend, might be multiplied and applied in other software tools that require integration of similar technologies.

Trend 3. The Influences of New ICT

Example 3.A. Wireless VLE

The evolution in learning and training at distance can be characterised as a move from distance learning (d-Learning) to e-Learning to mobile learning (m-Learning). These three stages correspond to the influence on society of the Industrial Revolution of the 18th to 19th centuries, the Electronics Revolution of the 1980s and the Wireless Revolution of the last years of the 20th century.

The European project *From e-Learning to m-Learning* [*4*] sets in place the first building block for the next generation of learning – the move from d-learning and e-learning to *m-learning*. The project sets out to design a Wireless VLE as harbinger of the future of learning (Fig 1.).

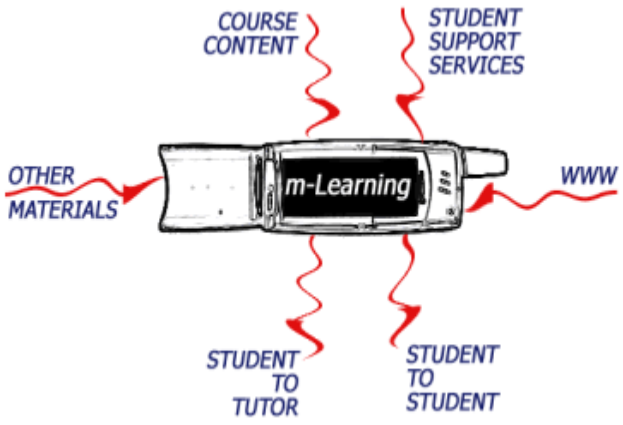

Figure 1. Elements of m-learning

More than 30 mobile learning initiatives in 2001 are presented and analysed in [5]. They demonstrate the growing importance of m-Learning as a field of educational research and endeavour. Mobile learning, the study of the provision of education and training from wireless devices, is situated clearly in the future of learning. The development of the didactic structures for the implementation of the mobile revolution will fall largely to the open universities and the government distance-training systems, as there is little likelihood that universities will focus didactically on students who choose to be mobile away from them.

6. E-Learning European Projects

The astounding progress of ICT in the USA and the falling behind of Western Europe in this domain brought up to existence the elaboration and the approving of *EU Action Plan*[2] for the development of the e-learning, including in particular the guidelines for employment. The first aim of the e-Learning initiative is to accelerate the deployment in the EU of a high-quality infrastructure at a reasonable cost. The e-Learning initiative places emphasis on creating appropriate conditions for the development of content, services and VLEs which are sufficiently advanced and relevant to education, in terms of both the market and the public sphere. Three subjects of the European research area for new learning environments will be explored in detail:

- *Development of systems. Research into, testing of, and forward studies on new learning environments, from the educational and technological viewpoints. Special attention will be devoted to using emerging technologies (GRID, satellite, digital*

[1] The prototype *PeU 2.0* has functional characteristics of a 3rd generation VLE.

[2] The "*e*-Learning: Designing tomorrow's education" initiative was adopted by the European Commission on 24 May 2000 [3].

radio and television, etc.) for the development of innovative applications for education and training. Education methods, organisation (learning communities, regions and organisations) and management of change are essential aspects in this context.

- *Virtual models. The concept of virtual campus; the new prospects for European universities; virtual mobility to complement and support physical mobility; access to education resources without constraints in terms of time or space; virtual networks for cooperation and collaboration.*
- *Special needs education. Taking account of individual differences in learning, and exploiting the potential of new ICT to provide remedial measures in the case of disability, exclusion, difficulty in gaining access to learning, or where conventional education does not work. Special attention will be given to the promotion of gender equality.*

The provision of considerable financial funding on this programme as well as the efforts of the different member states are at the origin of the real boom in the scientific researches and practical development in the field (Table 1).

Project	*Web-address*
An Internet-based virtual teaching and exploration environment	*http://kmi.open.ac.uk/~paulm/isvl.html*
Building Virtual Learning Environments	*http://www.icbl.qub.ac.uk/research/index.htm*
Collaborative European Virtual University	*http://www.cevu.org/Infos/cevu_course001_eng.htm*
Computer Assistance for Managing Collaborative Educational Processes	*http://www.sbu.ac.uk/ace/topframe.htm*
COSE - Creation of Study Environment	*http://www.staffs.ac.uk/COSE/*
Development a Virtual Community for Student Group work	*http://cssec.co.umist.ac.uk*
Distributed Interactive Virtual Design Studio	*http://sgi-hursk.lboro.ac.uk/~avrrc/jtap305/index.html*
E-Learning Disability Access	*http://www.comune.roma.it/cultura/biblioteche/blindnet*
Generic e-Learning Environments and Paradigms for the New European ICT Curricula	*http://www.cs-cyb-ee.reading.ac.uk/genius/*
Model for a European Networked University for e-Learning	*http://www.hsh.no/menu/*
Shared Virtual Learning Environments	*http://www.enc.hull.ac.uk/CS/SVLE*
Toolkit for the Management of Learning	*http://toomol.bangor.ac.uk/*
Towards Valid Collaborative Learning Tools from an Educationalist Perspective	*http://www.brighton.ac.uk/cscl/jtap*
Virtual Laboratory Developers Toolkit	*http://www.vldtk.ed.ac.uk*

Table 1. The projects selected follow the call for proposals published in 2001/2002[1]

The projects enumerated in Table 1. outline other interesting tendencies in the future development of VLE.

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ABOUT THE AUTHOR

Assoc.Prof. George Atnassov Totkov, PhD, Department of Computer Science, University of Plovdiv, Phone: +359 62 86 72, e-mail: totkov@pu.acad.bg.

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