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# VIRTUAL LEARNING ASPECTS OF CURRICULUM DEVELOPMENT IN ENGINEERING EDUCATION

## 1. Introduction

Two Leonardo projects concerning the topic in question are to be mentioned. Most of the partners in our recent „VELVITT" project (Virtual Electronic Learning in Vocational Initial Teacher Training) have been participating in a former international project „3L in 3T" (Lifelong Learning in Technical Teacher Training). Towards the end of the previous project we summarised the conclusions of using Information and Communication Technology (ICT) in life long learning. On one hand new technology has the potential of being able to match structure to the nature of the learning text and to individual learners' needs. On the other hand there is a phenomenon, known as "getting lost in hyperspace". Experience with teaching-learning programmes has proved that these programmes cannot replace teachers and discussions are irreplaceable. These shortcomings can be overcome if learning is organised in groups of learners to mix their experience in collaborative group work, which follows supervised independent study. Virtual learning environments integrate the advantages of individual learning and group learning and all the support that can be provided by ICT facilities. Computer networks allow for virtual presence from remote site, allow presenting course material in highly interactive form and allow presenting questions and get answers within minutes. Both the teacher and the learner can enjoy the privacy in their home environment. Internet due to the World Wide Web provides cheap and easy access to information sources of immense diversity. Interactivity is offered at a large scale and variety. In addition to tools, technology provides drill and exercises for basic skills. Recognising the opportunities of new ICT developments *Dr. David Lord* and *Dr. Matthew Pearson* from Huddersfield University (UK) initiated a new project supported by their experience on virtual learning environments. In 2003 the VELVITT project received foundation under the Leonardo scheme from EU. The web-site of the project: http://velvitt.banki.hu. The project is co-ordinated by Bánki Donát Faculty of Budapest Polytechnic (BP) and the consortium is formed by experts from Finland, Greece, Holland, Hungary, Portugal and the UK.

One of the main results of our VELVITT project is its 'Common module delivery'. The specifications for modules were prepared. "Basic teaching skills" and "Computer mediated skills" were offered for students of initial vocational teacher training. All partner institutions having vocational teacher training participated in the common module delivery. The first experience was gained with the guidance of the British team by using Blackboard for the module "Basic teaching skills". Due to

the technical development and free availability of Moodle the consortium decided to examine the inter-compatibility of these VLEs. With Finnish volunteering the new common module delivery was decided for "Computer mediated skills". Resources can already be reached on the Moodle VELVITT area of Tampere Polytechnic. In order to disseminate VELVITT products, specifications of the modules will be sent to initial vocational teacher training institutions on CD-ROM.

## 2. Pre-VLE Usage in Budapest Polytechnic

In the independent institute at that time Bánki Donát Polytechnic, development of the electronic syllabus has been started in the middle 1990s. This was supported by the Open Vocational Training Public Foundation, respective by Apertus Public Foundation. The first developments were created as multimedia based electronic syllabuses. Macromedia Authorware respective Macromedia Director was the development platforms used. The electronic syllabus developed in the material technology, machine engineering technology and education technology like in other higher education institutes were introduced in the normal daily education. This has made much easier efficient solution of the education methodology that appeared started from the end of 1990s due to the increased student number. Multimedia based syllabuses were used within limited frames in the night and correspondence education as well. Even that time demand for a unitary integrated electronic education system arisen, but our financial possibilities had not allowed us to purchase an expensive VLE system. After the integration in 2000 a very heterogeneous information system was created, in this way in the new Polytechnic the priority purpose was development of the infrastructure and it's unifying. Purchasing of an expensive VLE frame system was formulated as a perspective purpose only. After the integration every organizational unit took care and further developed their earlier electronic education system. HTTP servers serviced by the different faculties have had a key role, because the hypermedia based electronic syllabus (WBT) were placed on these servers. Maintaining and operating of the FTP servers respective mailing list, mail forums were supervised by the faculties, because more and more teachers recognized the opportunities of the Internet's services in extensive collaboration with the increased number of students.

The Polytechnic has undertaken only central electronic correspondence service and keeping of the "virtual study classroom" (NEPTUN) purchased for supporting the credit system introduced in 2002. However even these tasks were not too easy and much over the bearing capacity of the Polytechnic. The Information Committee of the Polytechnic played an important role in work out the operating conditions of systems. Based on all of these we can state that utilization of VLE system components have been integrated in the daily pedagogical work. At the turn of the millennium over the traditional education the night respective correspondence education has enlarged and respective several distance learning education has been started too. The engineering teacher, the technical manager, the light industry engineering and media technologic assistant education are worth to be mentioned. While the electronic syllabuses only extended the knowledge obtaining areas (information and

communication technologies, e-pedagogy and methodology for collaborative learning), the distance learning have required utilisation of the corresponding electronic frame system, where the competence modules, communication tools and the forms of collaboration determining the students independent and collaborative work would be integrated. Between the years 2000–2002 the hypermedia based electronic syllabuses that could be used in distance learning mostly were placed on web servers. The learning auxiliary materials developed by the lecturers, the electronic annotations, tests, electronic version of the methodological instructions (doc, rtf, pdf) were placed here. These publication forms were useful, because continuos updating of the syllabuses were simple, but these were developed for printed out media format, that supposed totally different learning environment. At the beginning of the VELVITT project in the regular, correspondence tuition and distance learning engineer teacher education of Institute for Engineering Education the following technically separated but pedagogically integrated VLE components were used:

- In order to promote individual learning certain chapters of some of our modules (multimedia, education technology, methodologies, etc) have been processed in the form of electronic syllabus (HTML, multimedia).
- The syllabuses of several modules (multimedia, methodologies, education technology, etc) have been made ready for download in electronic form (doc, rtf, pdf).
- Module-related student assignments have been submitted by upload on the FTP server.
- Student - teacher communication has taken place in the form of electronic correspondence.
- Module-related mailing lists, ensuring the manifold exchange of information, have been created.

## 3. The Basic Teaching Skills Module

The module aims are to develop an understanding of the fundamental issues and principles involved in teaching and learning within a specialist and to develop the skills in the design and evaluation of teaching and learning processes and resources. The Basic Teaching Skills module develops an understanding of ways in which people learn, together with the ability to design effective learning experiences and considers theory and practice relating to the teaching of a vocational subject. It also covers possible approaches to evaluating teaching and learning. In the case of the module relevant information (“ready knowledge”) was placed in the system shell in an electronic format (html, pdf, doc, etc). In the module Basic Teaching Skills the students independently processed the following topics in the course of acquiring information:

- Factors influencing learning (e.g. previous educational experience, motivation, learning style)

- Theories and models of teaching and learning (e.g. adult learning models, experimental and reflective models, cognitive and behaviourist theories, learning styles, motivational theories)
- Basic forms of collaborative learning
- Role of communication and language in teaching and learning
- Barriers to learning
- Opportunities for professional development for specialist teachers and trainers
- Organisations and networks, community-links, the role of teamwork. (*Smith,* 1999) Table 1 shows learning outcomes of the would-be-teachers at the end of the module.

*Table 1 Learning outcomes of the would-be-teachers*

Knowledge and Understanding Ability

- demonstrates a basic understanding of theories and models of learning
- produces the conditions of efficient collaborative learning
- understands the aims and philosophy of education and training in the specialist area
- understands the relationship between learning outcomes and the design of teaching and learning
- understands the role of IT and other skills in the specialist area
- plans effectively to achieve identified learning outcomes
- prepares and selects materials to support teaching and learning
- analyses communication within teaching and learning

The students had to produce a portfolio of evidence showing that they had achieved the module outcomes (3.000–4.000 words approximately). The portfolio should have contained the following elements:

- Plans for learning sessions and/or program of study are appropriate to particular teaching and learning situations, incorporating, where appropriate, IT and other key skills
- Consideration of VLE usage for collaborative learning
- Evaluations of the design and delivery of teaching and learning
- Consideration of fundamental issues and principles relating to teaching and learning within the specialist area
- Evidence of reflection on teaching and learning processes

## 4. Blended Learning by VLE Usage

The forms of electronic learning may be interpreted within the framework of traditional and distance learning alike. In the former case the so-called face to face forms of education are combined with the Internet-based learning environment. In the course of processing the modules Basic Teaching Skills I realised the form of

learning referred to as „blended learning" in the technical literature. Virtual classroom is defined as the entity that associates a course with one or more students and one or more tutors/mentors/facilitators with the purpose of reaching some common educational goals (realisation of course). Virtual classrooms use the services of the system to reach these goals. Besides the cognitive activity of electronic communication and knowledge acquisition, in the course of processing the modules Basic Teaching Skills as a result of Blended Learning, students had an opportunity to try the following types of face to face cognitive activities: classroom practice – between students and the teacher/tutor (5 times per term), tutorial – between the student and the teacher/tutor, or between the student and a student (collaborative learning), school teaching practice – between the student and the comprehensive school mentor (Table 2). These traditional forms of communication created an opportunity to debate in detail the syllabus to be processed, to discuss the questions arising during the solution of problems as parts of the portfolio, and to exchange experience gained during the teaching practice and relevant from the point of view of the module. Basic teaching methods in common module - Blended learning a combination of classroom-based training with self-paced e-learning):

- Classroom-based training: lectures with explanation and interpretation, seminars, discussions, group-work (e.g. analysing and comparing a given VLE system), individual working with teacher leading/under teacher guidance (e.g. first steps in given module)
- Self-paced e-learning: participation in email and discussion board communication, leading the debate, uploading new reference, collaboration in learning

*Table 2 Achievement of the common module*

Week Classroom (Face to face) Training Virtual learning

| | |
|---|---|
| 1 | Introduction of VLE and content of given module |
| 2 | Presentation of module aims, learning strategies and assessments Introduction of the content and format of the expected portfolio Talk about electronic based communication via discussion board |
| 3-6 | Active participation in debate in discussion board Discussion about lesson planning |
| 7 | Discussion about connections between chosen teaching methods and learning styles |
| 8-10 | Active participation in debate in discussion board Discussion about lesson planning |
| 11 | Individual consultation about lesson planning and collaborative learning methods |
| 12-14 | Active participation in debate in discussion board Discussion about lesson planning |
| 15 | Evaluation |

The most important teacher instructions in the virtual teaching-learning process are the following: interpretation of blended learning, giving viewpoints for analysing VLEs in general and the given module, assistance in theme choice, analysing the chosen theme from the point of view of knowledge elements (e.g. concepts), interpretation of the domains of learning (e.g. cognitive, psychomotor and affective), thinking about possible teaching methods, teaching materials, didactical tasks and constitutional and contribution forms, giving information formats and contents of portfolio, adding new questions to the discussion, encouraging non-communicative ("shy") students to participate in debate, calling students' attention to adequate articles, bringing relevant learning materials to students (*Toth*, 2004).

## 5. Cognitive Activities in VLE

*A, J. Romiszowski* arranges the two basic forms of cognitive activities, that is the mode of learning and the form of communication, along two parameters in VLE. The former may be of an individual, social or group kind while the latter may be of an online, real-time and synchronous kind or of offline, non-real time and asynchronous kind (*Goodyear*, 2001).

Combinations of these may manifest themselves in the most varied forms of electronic training: Web Based Learning, Computer Based Training, E-learning, and Virtual Learning Environment (*Ponti–Ryberg*, 2004). In the case of Web Based Learning access to the syllabus is by the web browser either via intranet or extranet. Syllabus reachable this way often contains access to other such training resources as for example reference tasks, e-mail addresses, notice boards and discussion board. Computer Based Training (e-Learning) is a form of electronic learning which aims at the acquisition of learner knowledge or qualifications. According to its form, the electronic syllabus may be of an optional storage-run and multimedia based kind and/or of a hypermedia based kind accessible via web server (*Toth*, 2003).

VLE is a form of electronic learning which takes place in an integrated syllabus-transmitting, communicative and student-registry system. Frame systems (Blackboard, WebCT, Moodle) contain standardised elements (LMS, SCORM) and may be run on web servers. These forms of electronic learning may be interpreted within the framework of traditional and distance learning alike. In the former case the so-called face to face forms of education are combined with the Internet-based learning environment. In the course of processing the modules Basic Teaching Skills and Computer Mediated Skills, we too realised the form of learning referred to as „blended learning" in the technical literature. Virtual classroom is defined as the entity that associates a course with one or more students and one or more tutors/mentors/facilitators with the purpose of reaching some common educational goals (realisation of course). Virtual classrooms use the services of the system to reach these goals. Analysing students' work in the virtual classroom as collaborative learning, we may distinguish the following cognitive activities:

### *a. Communication*

A primary form of communication in VLE is linguistic and formal communication. The former is based on the comprehension of a written text, on the presentation of an idea of one's own and on arguing, whereas the latter is based on a written form of expression free of grammatical rules (table, formula). Different forms of visual communication such as for example chart reading and interpretation were typical to a lesser extent only, while chart formation was not at all typical. The basic forms of electronic communication were the following:

- chat for on-line textual communication particularly between student and tutor/mentor/facilitator and students mutually
- mailing list is used by all groups of the users
- discussion board for sharing and discussing individual thoughts with the whole group

### *b. Knowledge acquisition (attainment)*

In the course of knowledge acquisition new knowledge is acquired via recording new information or exploration. Generally, knowledge acquisition involves learning at the same time, but not necessarily. Information recorded in the working memory may be deleted, forgotten or may be objectified in some outer store, or fixed (in for example an electronic notebook) without learning taking place. Learning interpreted this way means the acquisition of knowledge where information acquired is permanently built into the human background memory. Two basic forms of knowledge acquisition may be distinguished: the acquisition of information and problem solving. In the course of acquiring information „ready knowledge" is available, so it is only confined to the voluntary search, selection, comprehension and recording of necessary information. Problem solving is a cognitive activity where there is no „ready knowledge" at disposal, but it needs to be explored. In the case of the two modules relevant information („ready knowledge") was placed in the system shell in an electronic format (html, pdf, doc). In the module Basic Teaching Skills for example students independently processed the following topics in the course of acquiring information: the interpretation of learning as a process and a product, the most important theories of learning, the relation of *Gardner*'s multiple intelligence theory to education, the interpretation of Kolb learning styles, *Bloom*'s taxonomy and the process of lesson planning. (*Toth*, 2004)

The active application of „ready knowledge" as above was needed in problem situations in the course of which students had to prepare concrete lesson plans according to the following: *„Writing a lesson plan involves:*

- deciding on content and identifying appropriate aims and outcomes
- specifying an appropriate sequence of topics and tasks
- choosing teaching and learning strategies that will help the learners achieve the outcomes

- describing how your learners will demonstrate what they have learned *Stages in a lesson* Read the following scenario and critically analyse the session it describes and use this experience in your planning (Table 3)."

Table 3. Achievement of the common module

Stages Purpose Methods Introduction to set lesson in context to link to previous work to share aims and outcomes – domestic arrangements – ice breakers – presentation of aims and outcomes Development to present new learning – demonstration – chalk and talk discovery/research – brainstorm – discussion/debate – reading – case studies Consolidation to allow learner practice – practical/field work – exercises – discussion/debate – role play – assignments – group work Assessment to measure learner attainment – test/task/exam – observation – discussion – question and answer – quiz – tutorial Summary to provide link to next session/topic to set work – learners list 3 things they have learned from lesson – revisit aims and outcomes Evaluation to observe reaction and progress – brief discussion to obtain feedback – teacher reflection."

After that, students of teacher training had to fill in the following table (Table 4) and thus prepare the plan for 8–10 lessons. These plans were then put in practise during the teaching practices at secondary comprehensive schools. Using the experience gained in teaching, students gave evaluations of their own lesson plans. As the above examples also show, the preparation of lesson plans develops students' creativity. It is the very essence of creation that while it modifies students' existing knowledge, it also produces new knowledge (the planning and projection of all the cognitive activities necessary to give a certain lesson) and a new product, namely a lesson plan is created.

Table 4 A form for lesson planning

Topic: Module: Session no.: Tutor: Date: Time: Aim(s): Learning outcomes – by the end of the session the learners will be able to: Learning activity (including opportunities for Key Skill development): Assessment Resources Lesson evaluation:

*c. Thought* Both communication and knowledge acquisition are related to a third cognitive activity, namely thought. In other words, communication and knowledge acquisition in VLE demanded and so called forth students' thought activity as well. In this respect three kinds of activity can be distinguished: the transformation of existing knowledge in the interest of acquiring new knowledge, the recognition and arrangement of the relations between the elements of existing knowledge in the interest of acquiring new knowledge (comparison, identification, generalisation and classification), knowledge acquisition based on logical conclusions. Naturally, the basic aim of the cognitive activities presented above is learning. The maturity and efficiency of the learning ability primarily depends on the maturity and efficiency of the cognitive activities presented above as well as those of the cognitive abilities developing from them. That is to say, the ability of learning is best developed by the development of communicative, knowledge acquiring and thought abilities. In VLE, where students mainly had to perform a self-directed and self-regulated learning activity, the efficiency of learning was determined by the maturity of the abilities of

independent communication, knowledge acquisition and thought. The learning process in VLE can be best described by the Peter Jarvis model (Fig 1). (*Jarvis*, 1995)

Figure 1 Experimental learning model by P. Jarvis

He sets out to show that there are a number of responses to the potential learning situation. *Jarvis* used *Kolb*'s model [quoted in (*Toth*, 2004) and in (*Toth*, 2003)] with a number of different adult groups and asked them to explore it based on their own experience of learning. *Jarvis* was able to develop a model, which allowed different routes: non-learning, non-reflective learning, reflective learning (see below). To see these we need to trace out the trajectories in the figure he produced.

a. Non-learning cognitive activities

- Presumption (1→2→3→4).

This is where people interact through patterned behaviour.

- Non-consideration (1→2→3→4).

Here the students do not respond to a potential learning situation.

b. Non-reflective learning

- Pre-conscious (1→2→3→6→4 or 9).

This form occurs to learners as a result of having experiences in daily life of which they are unaware. Skimming across the surface.

- Practice (1→2→3→5→8→6→4 or 9).

Traditionally this has been restricted to things like training for a manual occupation or acquiring particular physical skills. It may also refer to the acquisition of language itself.

- Memorisation (1→2→3→6[→8→6]→4 or 9).

c. Reflective learning

- Contemplation (1→2→3→7→8→6→9).

Here the learners consider something and make an intellectual decision about it.

- Reflective practice (1→2→3[→5]→7→5→ 6→9).

This is close to what *Schön, D.* [quoted in *Smith*, 1999] described as reflection on and in action.

- Experiential learning (1→2→3→7→5→7→8 →6→9).

The way in which pragmatic knowledge may be acquired.

## Conclusion

The basic forms of electronic learning are Web Based Learning, Computer Based Training, E-learning and Virtual Learning Environment. A form of the application of electronic learning under traditional (face-to-face) teaching circumstances is Blended Learning. It is the form of teaching we selected while doing the modules Basic Teaching Skills, Computer Mediated Skills and European Collaboration. Students got acquainted with the basics of VLE, the system of modules' objectives and requirements, the contents of the portfolio to be prepared and the rules of communi-

cation on discussion board within the framework of traditional education. Opportunity presented itself here also for a more extended consultation about the teaching plan including different collaborative learning method to be prepared. VLE made it possible to process the electronic "background material" and to discuss it together and to collaborate with others with the teaching plan to be prepared. Having completed students' activities in VLE it can be stated that the basic aims of those were communication, knowledge acquisition and thought. The results of the collaboration were active participation in a debate on discussion board, a fully developed teaching plan as well as experience gained during the realisation of that plan in teaching. In my present work I took the various form and means of electronic communication and collaborative learning under close examination. Discussion board is an outstanding one of these. It is independent of time and space and it makes a flexible exchange of communication possible thus contributing to the further development of students' written communicative abilities.

## References


Goodyear, P. 2001. *Effective networked learning in higher education: notes and guidelines*. Lancaster University, http://csalt.lancs.ac.uk/jisc

Jarvis, P. 1995. *Adult and Continuing Education. Theory and practice*. Routledge, London Ponti, M. – Ryberg, T. 2004. Rethinking virtual space as a place for sociability: theory and design implications. *Proceedings of Networked Learning Conference*, Sheffield University, http://www.shef.ac.uk/nlc2004

Smith, M. K. 1999. *'Learning theory', the encyclopedia of informal education.* www.infed.org

Toth, P. 2003. Pedagogical Aspects of the e-Learning. In: *Proceedings of 2nd International Conference on Emerging Telecommunications Technologies and Applications and 4th Conference on Virtual University*, Kosice

Toth, P. 2004. Taking learning styles into consideration in e-learning based education. *Teaching Mathematics and Computer Science*, 2/2, p 385–396 Uskov, V. 2002. Design, development and teaching of innovative Web-Based Introductory Computer Information Systems Course, *Proceedings of the 32nd ASEE/IEEE Frontiers in Education Conference*, Boston