# Experience of the implementation of a cooperative and contributive learning model in teaching networking information technologies in conditions of emerging technologies

## Yuri V. Demchenko

TERENA, Singel 468D, Amsterdam 1017AW, The Netherlands E-mail;
demch@terena.nl

**Abstract:** In the modern networked information environment the main paradigm of professional education has sufficiently changed with regards to the actual roles of the teacher and students. New approaches in education and training should increase the assistance-to-contributive effect, i.e., education and training organizations should become knowledge based organizations themselves and should implement the KBCo corporate model. The contributive effect in IT education should shift from being a secondary process to a productive one- New approaches in professional education should utilize the learning process (or its results) to create an information and knowledge base for teaching the next generation of students and/or trainees.

Students become responsible for their own necessary knowledge acquisition based on their curriculum experience but the teacher has to manage the education process and set up an appropriate motivation system, in other words, the teacher will teach students how to learn and sets up a motivation framework for successful and timely curriculum performing.

The basic principles of education in a Networked Information Environment are formulated and discussed.

Students learn in cooperative project based environments oriented towards producing final results that will help them to acquire knowledge in adjacent areas of common project group competence. The contributive process of education in IT should work on developing meaningful information resources with will increase the national presence in Gil - Global Information Infrastructure.

Proposed approaches and new principles of education in the networked information environment are based on two years experience in active instructional methodology development at Kiev Polytechnic Institute. Results and problems are described.

The paper presents practical results and experiences in the development of new instructional methodology for the teaching of modern Networking Information Technologies, based on the Cooperative and Contributive Learning model in the rapidly changing conditions of emerging new technologies in the Ukraine. Paradigmatic change and the main principles of developing Instructional Methodology of Teaching in Networked Information Environment are discussed.

**Keywords:** Cooperative learning; contributive learning; information technologies; new instructional models: professional education; internet;
emerging technologies (countries with emerging technologies).

**Biographical notes:** Yuri Demchenko is one of the Project Development Officers at TERENA who assist the Task Forces and contribute to technical projects- He is currently responsible for TERENA Technical Program activities in building content oriented networks, middleware and security. He is also involved with a number of other internal and external technical activities. Prior to joining TERENA, Yuri worked at the Kiev Polytechnic Institute (KPI) as an Associate Professor where he used to teach internet and networking technologies. All his educational materials and related publications can be found at http://www.ua7.onc.org/demch/academic/index.html. Yuri graduated from KPI in 1981 with a diploma in Instrumentation and Measurement. In 1989 he received the Candidate of Science (Technical) degree. Yuri has been working for TERENA since September 1998.

# 1 Education and research in the global information environment

The successful implementation of Gil elements and its future sustainability requires a special focus on professional education in networking information technologies and concurrent training and user support activity, which will contribute to solving the problem of preparing workforce specialists for socially important areas of academic, industry and business activity in the country.

Education should respond to the global challenges of forming an Information Society by providing the necessary background for successful people living in this new knowledge based era, for example by [1]:

- forming a knowledge base and the motivation to constantly improve knowledge and skills,

- forming a moral code of coexistence in an open IS which accepts the majority of truths and the inadmissibility of harmful actions because of the global impact of any actions in a global information environment,

- encouraging life-long learning,

- free access for learning materials and training materials.

IT provides efficient tools in education for interaction with the external environment and facilitates knowledge acquisition owing to global access to information (and knowledge) and it allows the possibility to increase the number of experiments undertaken during learning.

The education area is now becoming the place where many technologies meet, and are tested by real practice and coexistence. Educational activity is becoming an important part of company activity (notwithstanding the structural affiliation - to a company or a university). Education becomes a conductor and promoter of new technologies and areas where new approaches and new social imperatives are forming.

New aspects of education and research in the networked information environment and IT usage are based on tools which assist the abstract thought process:

- facilitation and extension of the abstract thought process by extension of its information and knowledge base,

- providing tools for multimedia image manipulation and processing,

- replacing and supporting information processing by information/knowledge access in the growing structured information environment,

- increasing the contributive effect of education and training.

New approaches in education and training should increase the assistance-to-contributive effect, i.e., education and training organizations should become knowledge based organizations themselves and implement the KBCo corporate model. The contributive effect in IT education should shift from being a secondary process to a productive one. New approaches in professional education should utilize the learning process (or its results) to create an information and knowledge base for teaching the next generation of students and/or trainees.

Integrating the internet into the classroom will demand a special approach to curriculum design and the instructional methodology used should focus on reaching main teaching goals, because learners in such an environment can opt 'to stay' in the class or escape by internet surfing. Curricula have to take into account the existence of the internet as a global information environment. The teacher must be afraid that his/her students will be lost in the open global information space. Education and cultural globalization and internationalization should not impact on national cultures. In these circumstances education needs to inoculate learners from the outset with national and cultural values. (Students should accept priorities of national values in integration into the global IS). Throughout education and further lifelong learning, people should take on board new global criterias (but not change values) applying and adopting them to the national values.

This approach can play a constructive role even in the case of the inevitable 'brain drain' (physical and via teleworking) caused by the growth of transnational corporations and global workforce integration and migration. In general this process is inevitable because of the objective development of transnational corporations that utilize and integrate the most important value of mankind - human intelligence. The need to conform to an international level of skill and professionalism will raise the professional knowledge level among local specialists.

The development of Gil and the communication infrastructure will be facilitated by:

- the needs for a distributed knowledge-based workforce,

- the need for access to national and cultural information resources.

Rapid technology changes and an economy which is restructuring to take on board new technology in the Ukraine raises another problem with a 'professionally lost' generation. The wide demand for IT workers (and programming in particular) causes problems with the completion of professional education. Students that have at least basic knowledge in IT and programming are snapped up by many small companies to serve their IT needs. Faced with a difficult economical situation they are forced to earn money that, in general, contradicts with their need for further education. Young people in their third or fourth

year at university go to work without having completed their education, which could affect their potential for further professional growth in the future. Professional consciousness should correspond with the professional knowledge to secure constant and successive professional growth and knowledge acquisition.

## 2 A paradigmatic shift in professional education

In the modern networked information environment the main paradigm of professional education has sufficiently changed *vis-a-vis* the actual roles of the teacher and students. The old methodology was based on the concept of the classroom as the ultimate place of knowledge receiving where the teacher played the role of source and transmitter of information and knowledge and learners played the role of receivers. The teacher could learn from his/her own experience. But now with rapid technology changes very few teachers can teach using their own experience.

The problem for education is that competition between transnational industry leaders provides an increased pace of technology development and changes. Therefore, in the current climate the main paradigm of education has changed to cooperative and contributive learning in which the teacher plays the role of information producer and curriculum adviser but students act as information accumulators and knowledge acquirers. They become responsible for necessary knowledge acquisition based on curriculum experience but the teacher has to manage the education process and set up an appropriate motivation system, in other words, the teacher will teach students how to learn and will motivate them to achieve the goals of the curriculum.

Teachers using the new instructional methodology have to satisfy the following demands:

• teachers need a high level of initial knowledge and necessary experience in IT,

• the ability to work as a project team member and curriculum manager,

• the ability to organize the project team's work in such a way that all students accept the proposed conditions,

• they need to be able to dynamically manage the curriculum establishing and adopting criteria and flexible motivation principles oriented on the final results.

Students learn in cooperative project based environments oriented on producing final results that help them to acquire knowledge in adjacent areas of common project group competence. The contributive process of education in IT should work on developing meaningful information resources increasing national presence in Gil.

The real challenge for the Ukraine as a country with emerging technologies in the Professional Education of IT and IT based courses is constructivistic instructional methodologies which incorporate the active position of the teacher and students and tightly interact! with the global information environment:

• *Project or Problem Based Learning (PBL)* that is effective in the information and knowledge rich environment with developed infrastructure [2-4],

• or *Cooperative and Contributive Learning (CCL)* that is PBL adapted to the conditions of emerging technologies and developing communication and information infrastructure [5,6].

**3 Main principles of teaching in a networked information environment**

The practical orientation of educational courses facilitated the formation of the proposed principles of teaching and implementation of Modern Information Technologies in Technical, Technological and non-Technical education, formulated as a result of a practical project on the pioneer development of educational courses on Networking Information Technologies in Kiev Polytechnic Institute. These principles are based on Cooperative and Contributive Learning models and the proactive role of teaching and the creative role of learners. The new paradigm of education in the modern Networked Information Environment should be incorporated into instructional methodology development.

*3.1 Learning from the internet - contributing to the internet*

*3.1.1 The cooperative learning model and students' initiative*

Using internet/intranet technologies teachers and learners can mutually benefit from the implementation and mastering of new technologies. A key role in exploring this principle belongs to educational projects and relies on a Cooperative model of course management that effectively uses students' initiative in mastering new technologies.

*3.1.2 Contributional learning model*

In conditions where students commonly use computers and multimedia technology and of rapidly changing technology, teachers sometimes do not have strong practical technological experience. In these circumstances they should play the role of mentors and/or managers of the educational process or curricula. Teachers can propose a project which offers contributional learning where students or student groups work on projects that will actually be used to build campus computer networks, or develop information resources or other projects of benefit to society.

*3.1.3 Integration of traditional and distance learning*

The new networking environment provided by the internet/intranet eliminates the differences between traditional and distance learning, but stresses interactive on-line (IRC, conferencing) and off-line (e-mail, mailing lists) communication between teachers and students.

*3.1.4 The concept of 'active position'*

The complete implementation and full benefits of using the internet and new information technology in education can be only reached by using this principle that is very close to the idea of contributional. learning. It is not enough to give students and teachers internet access only. To use the internet effectively, faculties should start the development of their own internet resources and create their own internet presence.

## 4 A pilot educational program on networking information technologies and services

A pilot project on the development of an Educational Program and Instructional Methodology for Teaching Computer Networking and Internet Information Technology started in 1995 at the Computer Aided Design Department in Kiev Polytechnic Institute. Seventeen students in the first group successfully completed their Masters theses in June 1997. During their two years of Master education all students were involved and contributed sufficiently to the development of the technical and information base of the new educational courses.

The pilot educational program includes specialized courses in Computer Networks and Networking Information Technology and Services that could be developed on the existing information and technical base:

• Computer Networks Basics. LAN and WAN Technologies (2 credits)

• Internet working and Network Management (2 credits)

• Intemet/intranet Information Technology and Services (2 credits)

• Advanced Networking Information Technology (Security, Java, VRML, Internet Publishing, etc.) (2 credits)

• Internet Business Applications and Information Technology Business Process Re-Engineering (2 credits)

• The Information Society and Advanced Communication Technologies: Social and Cultural Impact (facultative)

The rapid development of modem networking technologies has demanded more than a 40% change in course content during the second year as well as significant changes in themes of educational projects. Information about new technology and standards was directly transmitted to students via lectures, classes and via the departmental server.

All courses are delivered via instructional and computer presentation materials that are distributed among students in paper and/or electronic form. Some materials are available on the educational WWW server (http://cad.ntu-kpi.kiev.ua/). This allowed the creation of an initial base of instructional and educational materials as well as to adopt and test Russian/Ukrainian terminology in real lecturing and educational project development.

_ Some practical experience is gained by students during the educational projects which includes the development of real networks for concrete academic and educational institutions including development of necessary information services to meet the operational needs of the organization and/or users' group. Also the practical installation of services and pilot information resource development is performed at a special educational laboratory base.

Two main components of complex educational projects are network infrastructure design and information server structure and content development. Projects are developed by groups of three or four students and include all the necessary components of a real networking project to design a campus or company's network including the organization of optimal cooperative work by the project group:

- Survey of existing situation,

- Defining a users' groups in the organization and their information resource needs,

- Network structure design,
- Choose hardware, software and communications and Internet Service Providers to complete the project by comparing companies/suppliers in the region,

- Corporate/organizational intemet/intranet information server design,
- Development of a dedicated WWW server information structure and its experimental installation on the educational server.

Topics for projects are chosen from a list or are proposed by students themselves. Most of the WWW servers developed were devoted to the realization of two initiatives in the department;

- *U'Pavilion* - WWW Server on the historical and cultural heritage of the Ukraine (http://park.kiev.ua/) [7]

- *Multiling* - Multilingual applications of the WWW/internet (http://park.kiev.ua/multiling/) [8]. In 1998 a project was supported by the TERENA Pilot Project on Multilingual mail Users Agent Testing [9].

During the design period all projects have their homepages on the educational WWW server in the CAD Department in special working directories (see reference page at http://cad.ntu-kpi.kiev.ua/academic/projects/webprj97.html). After completion and final editing by webmasters, web pages or templates are moved to their destination location on the departmental WWW Server and two other mentioned servers. The draft works are left on their working directories for future use by other students as templates.


## 5 Results

The main intermediate results of the pilot project are as follows:

1  Creation of an initial base of learning materials in the Russian language on pilot educational courses on Networking Information Technologies [10],

2  The development of training materials for the practical study of internet technology,

3  Involvement of students in the creation of an educational base and learning project examples as well as pilot testing of instructional methodology,

4  The creation of an educational server and the development of a student account management system,

5  The creation of resources for a dedicated information server on Ukrainian Historical and Cultural Heritage,

6  The formulation and implementation of the main principles of education in the networked Information Environment in real conditions of emerging technology.

In order to provide an efficient tool to test students' knowledge and provide feedback for course revision and improvement, a special test system was developed. The questionnaires consisted of 50 questions (randomly chosen from more than 100 questions and 1000 statements) covering all key items of the course. If officially adopted such a test system could be used for training management needs.

As a result of recognizing the advantages of providing education methodology and meeting the needs of the existing Networking market in the Ukraine, specialists and students from the department were asked to assist with the specialized internet/intranet exhibition EnterNet'96 and EnterNet'97 which took place in Kiev. The EnterNet Internet/intranet Network Operating Team (INOT) responsible for network design and maintenance was made up of students and experts from the CAD Department. Many students were involved in the development of intranet information resources for the exhibition's web server. Liaison with the Exhibition Company Euroindex Ltd. provides a good opportunity for students to see new technologies in action and to get acquainted with the IT market in the Ukraine.

## 6 Existing problems

The project encountered a number of problems for many reasons such as; technical, organizational, methodological and funding issues. Some of them can be discussed in
more detail:

1   Technical problems included:
   - slow and unreliable existing internet links that demanded special mirroring
     and caching of the main popular information resources (for example, RFC, Documents
     on Computer networking. Internet Protocols, Network Security, HTML and HTML
     Editors, etc.) on the educational server to avoid unnecessary traffic via the very slow
     external link of the Campus network,

   - absence of special tools for effective student account management,
   - the cost for the necessary configuration of the client PC for internet/intranet applications is
     quite prohibitive.

2  Methodological problems that included:
   - first of all, a lack of experience of teaching such modem courses in the Ukraine and
     FSU,
   _ •   an absence of instructional materials and handbooks in Russian and Ukrainian
   languages,
   - a small number of tutors with sufficient practical experience in Computer Networking to
     cover all items of the curriculum.

3  Funding problems included a lack of necessary funding the proper implementation of such kinds
   of educational projects. Modern Networking Information Technologies are quite expensive and
   their implementation demands corresponding funding.

**7 Summary**

The background to the successful realization of the discussed project to develop a new educational program and instructional methodology is the idea of cooperative and contributive learning precipitated by students' enthusiasm and the great interest in professional and business circles in the Ukraine.

Such pioneering work will create a basis for the wider implementation of IT Networking in the university environments and also the wider community. Some areas of useful international cooperation are to be found in the development of distance learning based on existing results and the technology for better utilization of developed educational courses and instructional methodologies for different university subjects.

The experience described here is very simple to implement but demands experienced and devoted teachers capable of 'playing coach'.

## References

1  Demchenko, Y.V., 'Strategic aspects of national power and forming knowledge based society in conditions of information revolution', http://park.kiev.ua/~demch/philosophy/kbs-essay.htmi

2  'Introduction to problem-based learning', URL: http://www.imsa.edu/team/cpbl/cpbl.html

3  'Overview of project-based learning', URL: http://bellnet.tamu.edu/res.grid/ovpbl.htm

4  Lenschow, R. (1997) 'On the electronic highway to lifelong learning: a paradigm shift in learning and technologies', *ICTE'97 Proceedings, Oslo,* 10-13 August.

5  Demchenko, Y.V. (1997) 'New paradigm of education in Global Information Environment: learning from the internet - contributing to the internet', */NET'97 Proceedings, The Internet: Global Frontiers, The Annual Meeting of the Interne! Society,* 24-27 June, Kuala Lumpur, Malaysia.

6  Demchenko, Y.V. (1997) 'Cooperative and contributive learning - the real choice to push professional education in Networking Information Technologies in Ukraine and CIS', *JENC8 Proceedings,* Edinburgh, Scotland, 12-15 May, pp.822-7.

7  U'Pavilion - Ukrainian Internet Pavilion, WWW Server about Ukrainian Historical and Cultural Heritage, http://park.kiev.ua/

8  Multilingual support in WWW/Internet applications, http://www.ua7.one,org/multiling/

9  TERENA WG-I18N/WG-MSG Pilot Project "Multilingual mail users agent testing', http://www.lerena.nl/lib/mlmua-fr.html

10 Educational and Training Courses on Internet and Computer Networking Technologies, http://uazone.org/demch/academic/courses.html