

## Combination of Network Computer-Aided and Traditional Teaching Methods in Delivering High-Tech Master's Degree Courses

Tatiana S. PETROVSKAYA; Victor.A. KILIN; Sergei A. GORISEV

Institute for International Education, Tomsk Polytechnic University 30, Prospect Lenina, 634050 Tomsk, Russia, tel: +7 3822 563807, fax: +7 3822 563299, vak@tpu.ru

**KEYWORDS:** *international cooperation and education, high technology, distance learning, Master's degree, engineering, quality management, industry, business*

**ABSTRACT:** *The XX century has changed the appearance of the world community, and the main factor of this transformation is the scientific and technological progress. The high-technology (HT) innovations play the great role in solving vital problems of the society development. Among them, the problems in ecology, health protection, personal and social security, energy- and resource-saving, production of new materials, and others are very actual ones. Who will be able to solve these problems in XXI century?*

*The answer is evident - specialists of good competence in creative solving engineering, economic, social problems and of strong responsibility as to an employer, insurance company and lawmaker in sense of the quality management. Therefore, leading educational institutions should take an initiative in and responsibility for training well-qualified specialists having necessary knowledge, skills and attainments in HT.*

*Nowadays, Tomsk Polytechnic University, as an elite Russian scientific and educational complex demonstrates such initiative through opening the HT education to everybody despite geography. The university has developed a new approach to delivering educational programmes, which combines the long-distance e-learning and on-campus full-time labs and research. The staff and facilities of overseas partner universities are also involved in the educational process thus giving an opportunity to students to get both the international experience in HT and the country-study. Also, the approach opens doors for graduates to Ph.D. studies at any partner university as well as to a successful carrier in industry and business.*

*The delivering of the five Master's degree programmes: Generation and Application of Electromagnetic Radiation, Physics of Condensed Matter, Computer-Aided Design of Advanced Materials and Technologies, Methods and Instruments for Non-Destructive Quality Testing, Discharge and Plasma Technology has started at TPU in 2002-2003 academic year.*

*The first-step results show the great interest of students to the new didactics and, at the same time reveal certain methodological, technological and administrative problems.*

### INTRODUCTION

According to experts' appraisal, the world-wide renovation of information runs ahead of the mankind biological rejuvenation. The total amount of information being in possession of the humanity is near to that of human genetic information. On the other hand, people are expected to change a field of their professional activity to another one in the course of their life, time and again, because of globalization and internationalization of economics and informational flows, due to development and widespread adoption and use of high technologies.

The conception of Life-Long-Learning (LLL) meets the requirements and needs of an informational-society-individual in the enhancement of his knowledge, skills and abilities. Generally speaking, this conception responds to the solicitudes of the human society in its sustainable development.

Nowadays, we observe a steady rise of the high technologies share in industry that demands many well-educated specialists in different field of engineering and management. Educational needs of an individual are rising.

Other evidence lies in unacceptable terms of traditional learning mode in classrooms for those people who, being graduated a few years ago and working in industry, would like to improve their qualification. The companies employed such people in are also interested in the improvement of the staff professional

competence but would not like to relieve them of occupied positions for a long time. Employees also beware of dismissing and losing their work, if they would throw over a company for some time. Thereupon both employers and employees “feel” certain risk.

Therefore many new educational modes such as intensive short-time courses, long-distance e-learning via Internet, and internal “in-company” teaching through attracting leading university professors are developing and used for the staff’s quality improvement.

## **MATTER OF APPROACH, PROBLEMS, AND DISCUSSION**

Tomsk Polytechnic University, as a leading Russian scientific and educational institution, opens an access to the life-long-learning for both individuals and companies staff despite geography of living and location, especially for those who deal with high technologies (HT). The university has developed a new teaching approach that combines the long-distance e-learning of advanced engineering courses via Internet and the on-campus full-time labs and research with the use of up-to-date equipment, machinery and other current facilities. The faculty and facilities of overseas partner universities are also involved in the teaching process thus giving students an opportunity of getting both the international experience in HT and the country-study. Also, the approach opens doors to the advanced PhD studies at any partner university as well as to a successful carrier in industry and business in a home country or abroad.

We believe that the university educational courses in HT and the new teaching approach should be of great interest for the companies, which are aiming at the development or thoroughgoing changes of the technological processes, at the application of the new scientific achievements to production, at operation and management improvement.

Upon successful completion of the Master’s courses the graduates would enjoy deeper knowledge in engineering and management, nimble mind, thorough thinking, ability to engineering innovations applications. All that would enable them to radically change and effectively control technological processes, thus giving opportunity to obtain quick promotion and become a top-engineer.

M.Sc. courses details: It is presupposed that the total duration of study (2 academic years) is subdivided into two main stages, while the course curriculum consists of three modules (sub-curricula): (1) theoretical disciplines in advanced science and engineering, (2) disciplines in burning issues of modern science/technology, and the methodology of science, (3) management, research and engineering methods, on-campus labs and research.

During the first stage (1 to 1½ academic years) a student may take disciplines through long-distance e-learning (via Internet) mainly. For all that the student should follow scheduled virtual classes, consult with a teacher, fulfill quizzes and tests, and take exams. He will also have 2-3 opportunities of face-to-face discussions with teachers or taking exams on the university campus (partner university campus, university branch campus).

The second stage presupposes the study, research and completion of the Master’s thesis on the university or alternative campus under the guidance of university professors. In case the dissertation theme is in line with the company’s activity, at least a part of research and the preparation of the thesis could be done at that company.

Thus, the new teaching-learning approach is based on both the e-learning via Internet and research in well-equipped labs or at top companies. It is important to mention that this approach requires a special training of the teaching staff involved. Also, students meet specific learning problems different from usual ones. These problems have also to be taken into account by teaching staff and the university administration.

The special training of teacher includes:

- Study and mastering of conception, content and methods of web-based teaching and learning.
- Study of the web-based educational environment potential and mastering the appropriate skills.
- Active participation of teaching staff in the development of the modules using the Web Course Tools (WebCT) that serves as a base of delivering Master’s courses.
- Faculty practical training aimed at acquiring good skills in communication and assessment tools.

Students’ progress and success in studying strongly depends on the following factors: active and regular self-instruction, strong motivation, aptitude for the well-directed efforts in studying, and good-level skills in informational technologies (IT). Therefore, the student’s accreditation of prior learning

procedure (APL) is provided. For those students who have a deficiency in IT skills, the specific course “IT in Science and Education” is included in the first term curriculum.

Along the today’s stage of the project running, a task of the concordance and synchronization in parallel teaching-learning a few (under 7) disciplines via Internet has been revealed. The schedule optimization strongly influences on the student’s learning load and hence, on his progress in studying. This factor is even of greater importance, if a student concurrently works in a company.

However, not only the student’s learning load but the teachers’ one has been also found important in the teachings-learning success. One should always keep in mind and take into account our initial desire of using the advantages of the web-based educational environment and instruments to attain the personalization of teaching-learning procedures.

We also have to mention that the new educational approach demands a renovation of the educational management at the university. That is why the following arrangements and legislative enactments in piloting the project have been done:

- Additional university regulations and corresponding documentation.
- The quality management procedures for teaching and auxiliary processes.
- Renovation and upgrade of the computer and network facilities.

Finally, the intake of overseas partner universities into the project piloting opens new opportunities for students in getting international scientific experience and country-study.

## APPENDIX

Here the brief description of a M.Sc. programme “Methods and Instruments for Non-Destructive Quality Testing” is presented as an example. Quality control is the most important part of the product-quality management. Usually, total quality investments are of more than 50% of the primary goods cost. The Master's programme is run by the Department of Physical Methods and Instruments for Non-Destructive Quality Testing of the Research Institute for Non-Destructive Testing under the leadership of Prof. V.K. Kuleshov in collaboration with scientists of the University of Saarbrücken, Germany.

Total required for graduation	42 credits
<p><b>Core Courses (12 credits):</b>  Modern Issues of Science (3 credits)  Power Electronics (3 credits)  Electronic Devices and Systems (3 credits)  Measuring Instruments (3 credits)  <b>Specialization Courses (16 credits):</b>  Radiative Diagnostics (3 credits)  Acoustic Diagnostics (3 credits)  Electromagnetic Diagnostics (3 credits)  Infra-Red Testing (3 credits)  <b>Electives (4 credits):</b>  Effectiveness of High Technology (2 credits)  Project Management (2 credits)  Optical Electronics (2 credits)  Microprocessors (2 credits)  Statistical Analysis and Quality Management (2 credits)  Methods of Direct Diagnostics (2 credits)</p>	<p><b>Research (4 credits)</b>  <b>Master's Degree Thesis (6 credits)</b>  <b>Master's Degree Thesis Topics:</b>  Development of Codes for the Diagnostic Mode of Magnetic Powder.  The Study of Gas-Discharge Converter Frontiers in a Register-Galloping Mode.  Reconstruction of Compton Tomography Based on Converter Wavelets.  The Reciprocal Projection Method in Compton Tomography.  The Study of Ultrasonic Detector Reflectance.  Hidden Flaw Detection with Penetrating Agents.  Automated Ultrasonic Complex for Measurement of Railroad Wheel Pairs.  Methods and Instruments for Coating Testing.  Applications of Converter Wavelets in Active Infra-Red Testing</p>