Establishment of Innovative Multidisciplinary Centres for the Development of Virtual Laboratories in Biology and Medicine

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The Wider objective of the project is the implementation of the knowledge triangle of education, research and innovation through Multidisciplinary Innovative Centres for the Development of Virtual Laboratories in Biology and Medicine (MICVL) set up in Eastern Neighbouring Area Universities (ENAU) using Virtual Medical Microbiology Laboratory as a pilot product. The centres will produce innovative commercial research-based products for education and science in Biology and Medicine using research and innovative methodology in Information Technology. Each MICVL triangle will incorporate 3 distinct groups that will contribute to a joint product:

I. Innovative Technology/Research Group;

II. Theoretical/Educational Group;

III. Business Development Group.

These groups will include academic staff, PhD and MSc students from the areas of IT, Biomedicine, Marketing/Business Development. Each MICVL will receive a formal status as a separate commercial unit within the ENAU infrastructure. All 6 MICVLs will be equipped with modern servers and appropriate software. Staff involved in the MICVL will undergo intensive training in IT innovative technologies and methodology and in Marketing in EU partners.

One of the specific objectives will be development of a pilot product: a Virtual Medical Microbiology Laboratory (VMML). Academic staff from ENAU and EU partners will work closely on a VMML. Team-members from Business Development Groups of each MICVL will be responsible for developing an efficient optimal scheme of VMML commercialisation and advertising. As a part of the advertising strategy, a special Website will be created by the IT Group for the introduction of end-products produced by MICVLs. The dissemination of the project's outcomes will include both internal and external elements at national and regional levels. Particular attention will be paid to increasing awareness of the technology in wider society of the region and establishing links with relevant IT enterprises.

Rationale for Project

Higher education systems are well on their way in addressing the challenges created by the fast developing new technologies and seizing unique opportunities to improve learning. The strategy for enhancement of learning has emphasised a shift towards using innovative educational technologies. To support these strategies, we propose to establish Multidisciplinary Innovative centres for the development of Virtual Laboratories in Biology and Medicine (MICVL) in each participating Eastern Neighbouring Area University (ENAU), in close cooperation with the EU partner universities. In addition, this collaborative project intends to provide resources in educational technology to bridge the gap between research and education through introduction of innovative technologies.

The ubiquity of digital technologies has already changed learning attitudes, cognitive processes and knowledge acquisition patterns. Today's multigeneration student body requires educators to understand generational differences, particularly in terms of technological ability. The new

generations of learners are digitally literate, they think more visually, and in a non-linear manner, they practice multitasking and give preference to multimedia environments including 3D systems. In traditional learning environments they are easily bored and need a variety of stimuli not to get distracted.

Looking at the way in which digital technologies have changed how people access and manage information, it can be seen that a new learning paradigm is emerging. The new paradigm can be summarised as follows:

(a) Learning in the digital era is fundamentally collaborative in nature;

(b) The learner plays a central role in the learning process – not as a passive recipient of information, but as an active author, co-creator, evaluator and critical commentator;

(c) As a consequence, learning processes are becoming increasingly dependent on IT technologies.

Despite these requirements, the application of IT technologies within Biological and Medical education has yet to be fully exploited. This leaves extensive opportunities for developing new approaches to course delivery and assessment in these subject areas. Even within EU member states only selected universities have adopted a wide range of e-learning methods based on IT technologies for teaching and assessment in Biology and Medicine, and ENAU are only at the beginning of this road. It is important that they are part of the development, not always being several years behind.

Establishment of MICVL in Biomedicine in the each ENAU can solve these problems by:

- Creating virtual simulations for various parts of the learning processes;
- Creating opportunities to engage the Faculty to further use the products developed by MICVLs for learning;
- Participating in research opportunities to better educate Faculty, staff, and students in the use of innovative technologies as they relate to teaching and learning;
- Involving students in the development and feedback on the IT-based e-learning material, joining in one team a customer and an educator.

Another noticeable reason why this project will be beneficial is that the design of virtual simulation (VS) packages that will be created within the MICVL will provide an opportunity to organise educational classes with limited resources such as laboratory space, funding and number of teaching staff. This is particularly important for restructuring ENA countries, although in the current economic climate creation of cost-saving VS will be equally beneficial for the EU partner universities. Importantly, VS is a perfect tool for providing distance learning courses, that converges with the current successful EACEA-158627 project on the development of DL technologies in the Southern Caucasus.

The first pilot product created by the consortium of MICVLs will be a Virtual Medical Microbiology Laboratory (VMML) across the educational degrees (BSc, MSc) and also applicable for PhD students. A Virtual laboratory (VL) will provide students with the opportunity to conduct research applying virtual experiments. Thus, it will help linking theory and practice, education and research, while integrating lectures, labs and reading in the process of carrying out virtual experiments.

Subject-related benefits of the development of VMML include:

- raining in the handling of dangerous microbes and/or reagents;

- opportunity to practice aseptic techniques outside normal laboratory hours;
- unlimited cost-free practice with media and reagents for performing and interpreting laboratory tests;
- one-touch reference books covering bacteria, laboratory tests, media, and reagents;
- ensuring that students come to the lab better prepared for the day's work;
- providing a way to allow students to catch up during or following absence;
- assistance in planning and simulation of microbiological tests for the research purposes.

To ensure the sustainability of MICVL, the main IT and teaching staff will be extensively trained at EU partner universities in IT technologies for teaching and assessment, as well as in pedagogical aspects of the e-learning. Since teaching staff are the key enablers for the introduction of VSs into learning and research contexts, MICVLs staff will further train teachers from other ENAUs in IT-based teaching.

MICVLs will continue creating new VS packages to follow VMML upon the completion of the project.

The role of every participant organization in the project has been clearly outlined. The ENA partner universities will define and present the main problems they are facing to establish MICVL. The knowledge , expertise and the working experience of the EU Universities will be used to plan and to implement the project tasks. The joint actions and efforts of the Consortium will ensure the high quality and viability of the established knowledge triangles of education, research and innovation in Virtual Laboratories in Biomedicine as laboratory space, funding and number of teaching staff. This is particularly important for restructuring ENA countries, although in the current economic climate creation of cost-saving VS will be equally beneficial for the EU partner universities. Importantly, VS is a perfect tool for providing distance learning courses, that converges with the current successful EACEA-158627 project on the development of DL technologies in the Southern Caucasus.

Quality

The strength of this proposal is the very well structured and academically advanced consortium of EU and ENAU. It has been established through the successful Multiplier JEP-23070 paving the way for success of JPCR-158627, (project coordinator Dr Nino Porakishvili, University of Westminster, UoW) focussed on the development of DL technologies. The project JPCR-158627 in 2012 won a very prestigious UK Times THE Award (Times Higher Education) as the best International Collaboration of the Year.

Previous TEMPUS projects JEP-10207, NP-2117, JEP-23070, coordinated by Professor Peter Lydyard (UCL and currently UoW), have contributed greatly to the restructuring of higher education in Biomedicine in the Southern Caucasus through the supply of essential teaching, communication and laboratory equipment, teaching material, training and curricula.

A previous version of this application was submitted in 2012. In response to the evaluation report we renewed the composition of the consortium by introducing SDASU private university who never benefited under Tempus program, and two new members of the Consortium - ONU and LNU. BIOANIM, a private IT company, also never benefited from Tempus funding, and remains a valued member of the consortium.

UoW, applicant and coordinator, has led the development of education in emerging technologies and modern professional practice in the UK. Currently UoW is coordinating the establishment of novel MSc course by flexible learning at Southern Caucasian Universities. Professor Peter Lydyard

has strong collaborative links with Georgian and Azerbaijani universities and will be assisted by the deputy coordinator Dr Nino Porakishvili and project administrator Ms Maka Bakradze. UoW IT team is led by the Senior Learning Technologist Ms Federica Oradini from Westminster Exchange that concentrates on Innovative Knowledge Transfer Technologies (http://www.westminster.ac.uk/about-us/schools/exchange). UoW will provide training in the Health and Safety component of the virtual laboratory using decision-making software and virtual Worlds, as well in the production of videos and podcasts.

The University of L'Aquila (UNIVAQ, Italy), has been developing DL and e-learning teaching formats for many years. Professor Guido Macchiarelli will lead the UNIVAQ team and provide design and deployment of a virtual electron microscope. Dr Giovanni De Gasperis is a leading expert in IT-based learning in Italy, and together with a group of IT experts will be converting scientific and learning packages into virtual simulations using Unity3D simulations and OpenSim (see Nightingale Island http://vimeo.com/35401130). UNIVAQ will extensively train ENAU staff in Cognitive Science applications, Technology enhanced learning tools, Immersive learning worlds and metaverses.

University of Brest (UBO, France) offers a wide range of skills in technology transfer, innovation and virtual reality (see http://www.cerv.fr/ and http://www.lab-sticc.fr/). The UBO team, lead by Dr Jean-Pierre Pennec has produced virtual simulation software for research and pharmacology. He will be assisted by a strong group of IT-technologists to develop multiagent software with advanced graphical interfaces with multicore programming and train ENAU staff.

BIOANIM (Slovenia) is a leading company that produces and markets scientific and educational animation software in Biology and Medicine. Dr Tomaz Amon has been involved in several successful EU projects including Minerva and Framework projects, and is an associate of Dr Giovanni De Gasperis of UNIVAQ (see www.bioanim.com). BIOANIM will be involved in training and production of VMML.

TSU (Georgia) has a strong IT department, has computer clusters and is able to provide the online support required for virtual learning tools including the regional on line platform for the project management and dissemination. TSU staff speak fluent English, are accomplished teachers and researchers and have been trained in the UK, France and Italy during previous TEMPUS programs in modern teaching and assessment technologies including distance learning. Contact person Dr Gachechiladze has vastly contributed to the previous TEMPUS projects. MICVL established at TSU will be a regional center to facilitate interactions between ENA countries. Dr Nino Amaglobeli, an IP expert, will advise the consortium on the IP issues associated with the VS-based products. Analogue services are not yet established in Azerbaijan or in Ukraine, hence our decision to affiliate the IP expert to the regional MICVL at TSU.

SDASU (Georgia) cooperates with universities in Europe, USA and post-soviet countries, takes part in international exchange programs. Development of DL and Virtual simulations is one of the strategic priorities for SDASU.

BSU (Azerbaijan) is a leading scientific and educational centre in Azerbaijan. They are currently involved in JPCR-158627, and are particularly interested in the establishment of MICVL. Contact person Professor Akif Guliyev, has been instrumental in the success of previous TEMPUS projects at BSU.

Azerbaijan Medical University is involved in innovation and restructuring of Medicine in Azerbaijan. AMU gathered a strong IT team and will be able to provide the online support required for virtual simulations. Contact person Professor Gulnara Nasrullayeva is a very experienced TEMPUS manager who has been involved in several previous TEMPUS projects. Odessa National University is one of the main state universities in Ukraine. There is an IT Educational and Research Centre at ONU for

training in IT technologies, establishment and launch of information systems for the management of inter-university education and quality provision. ONU is highly experienced in TEMPUS project management.

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Lviv National university is involved in international joint projects, has a well equipped IT department with intranet and internet facilities, and establishment of MICVLs is one of its current priorities.

Content and Methodology

The Main aim of this project is the Establishment of Multidisciplinary Innovative centres for the development of Virtual Laboratories in Biology and Medicine (MICVL) that will produce virtual simulation (VS) packages for educational courses. It intends to provide Eastern Neighbouring Area Universities (ENAU) with innovative ways and methods of learning, to support IT -based learning, promoting and improving motivation and learning involvement, with the help of EU partners who have appropriate experience in this field. A Virtual laboratory will be a suite of educational resources and tools chosen and developed to provide education and teaching within a specific discipline in Biology and Medicine. We anticipate that MICVLs will give rise to new learning and research methods that are adequately fitted to the subject and allow students a more inventive, imaginative, complex and complete investigation of the subject matter, and build a bridge between theoretical study, research and professional practice.

Objective 1 – To establish Multidisciplinary Innovative Centres for the Development of Virtual Laboratories in Biology and Medicine (MICVL) in each participating Eastern Neighbouring Area Universities.

Objective 2 – To create a Virtual Medical Microbiology Laboratory (VMML), as a pilot product for the established MICVL.

Objective 3 – To develop an efficient optimal scheme of VMML commercialisation and advertising.

Objective 4 – To disseminate the project outcomes applying strategy of both internal and external dissemination.

Project implementation is planned to be accomplished within 4 stages:

The first stage will be devoted to building an effective competent team of national MICVL with the regional centre at TSU. Each Centre will be led by a Head of the Centre and 3 groups of team-members:

I. Innovative Technology/Research Group will include IT specialists, post-graduate and BSc students from Applied Mathematics and IT Departments. The aim of this group will be to create Virtual Simulations (VS) that will also contribute to PhD projects.

II. Theoretical/Educational Group will include academics with an appropriate Biomedical background. The aim of this group will be to establish the academic content for the VS developed by Group I.

We increased the number of the MSc and BSc students in Groups I and II of the ENAU teams in response to the project evaluation report from the 2012 selection.

III. The Business Development Group will include a consultant from the National Intellectual Property (IP) Centre (in a regional MICVL) and a mixed group of IT specialists and academics. The aim of the group will be IP support, marketing and advertising of the end-product. We will put more emphasis on identifying relevant national IT enterprises to set up links for further sustainability of the project is response to the 2012 evaluation report.

At the second stage, we plan intensive training of ENAU staff with expertise in IT and Biomedicine. Some of the training will be organised on line using video conferencing. In parallel, resident intensive training sessions will be held in each of the EU partners based on the expertise in particular type of the virtual technology, e.g.:

UoW: Virtual Learning Environment (VLE); Health and safety Virtual Simulations; podcasting and videostreaming;

UoW and UNIVAQ: problem based learning (PBL);

UNIVAQ: locations in virtual worlds; OpenSim;

UNIVAQ and UBO: Unity3D simulations;

UBO: advanced graphical interfaces with multicore programming;

BIOANIM: scientific and educational animation software.

At this stage MICVLs will be equipped with computers and software and will start working on the web pages design.

In response to the 2012 evaluation we must stress that although computers and software have been purchased during previous Tempus projects and can be used for DL purposes, but they age too fast. It would not be possible for MICVLs to produce high quality Virtual packages without relevant modern IT equipment.

Setting up MICVLs at ENAUs will be finalised by formalising the status of each MICVL as a separate unit affiliated to an ENAU.

Each MICVL can be represented as a triangle with the tips occupied by the three Groups. All 6 MICVLs from 3 ENAU will be integrated making a regional ENA triangular network.

The third stage plans to create the Virtual Medical Microbiology Laboratory (VMML), as a pilot product scheme. For this purpose the Group II (Education) in consultation with Group I (Innovative Technology/Research) of each MICVL will build the academic content for the proposed VMML. This collaboration will be essential in determining the relevant IT technologies to use for each aspect of the virtual laboratories. The choice of resources, delivery platforms and technology will be informed by both the educational and practical requirements/restrictions to ensure that the eventual solutions are usable, practical and effective.

After the first six months the workshop at the regional centre (TSU, Georgia) will be organised. Following its decisions, the final version of academic content of the VMML will be produced. In order to convert the academic content into virtual language using conceptual models and scenarios for each topic, the project Consortium will jointly design the virtual packages within the proposed VMML using advanced software, computer technology and expertise acquired during the training of ENAU staff.

Development of the virtual packages for VMML will be based on:

(a) a database for the classification of microorganisms – causative agents;

(b) an extensive image library and animations;

(c) video-recorded live experiments;

(d) an extensive list of on-line references and Web-resources;

(e) virtual world locations.

The following core scenarios for VMML will be developed into virtual packages:

(a) laboratory organisation and design;

(b) necessary equipment, its operation and care;

(a) health and safety procedures, identifying wrong practices in the virtual lab;

(c) preparation and simulation of experiments designed for teaching and research purposes;

(d) sample taking, examination and classification of microorganisms;

(e) detailed examination of selected Case studies in infectious diseases. Some studies will be of the most common infectious diseases cases and others where organisms are too dangerous to be handled in standard microbiology laboratories or require special facilities e.g. Tuberculosis and HIV.

The major subject-specific technological approaches will be as follows:

(a) 3D-imagery of laboratory;

(b) cartoon-generated laboratory scenarios;

(c) mathematical models;

(d) second life elements: OpenSim, Unity3D, etc.

The laboratory itself will be a portal that provides a central point where all the resources can be accessed. This may exist in multiple forms, which can be evaluated and scaled according to the technology available. It is anticipated that the laboratory will exist in an interactive 3D form, though this may be mirrored with a lightweight web portal that allows access to provided resources. This work will become a subject for interdisciplinary MSc and PhD research projects in Biomedicine and IT technologies at ENAU and EU universities.

The final stage of the project is the dissemination and sustainability of the results.

The following long-term perspectives will contribute to the sustainability:

(a) Setting up academic, technical and financial background for the sustainability of the project;

(b) Deepening partnership with EU partners and strengthening links with regional partners;

(c) Training of ENAU staff;

(d) Making effective PR campaign at national and international levels;

(e) establishing links with relevant IT enterprises;

The dissemination of the project outcomes will include both: internal and external dissemination.

The approaches to internal dissemination will be as follows:

(a) Working out a mutual action plan for internal dissemination;

(b) Promotion of the model of MICVLs for other areas, beyond Biomedical education;

(c) Organization of informative seminars for academics and for students;

(d) Use the on line resources to spread information for interested groups and individuals;

(e) Involvement of IT MSc and PhD students from the Faculties of Business and Marketing.

In the framework of the external dissemination process, the following activities will be performed:

(a) Publication and dissemination of flyers, leaflets and booklets to target groups by the consortium through the progress of the implementation of the project at the regional level;

(b) Organisation of informative seminars for administrative and academic staff of non-partner regional universities;

(c) Spreading information to the wide society through seminars and mass media (Web, newspapers TV and radio broadcast);

(d) Organisation of discussions on request from regional universities and wider society.

The promotion of the project will be supported by the concluding seminar held shortly before closure of the project, hosting the participants and main stakeholders from every partner country. The seminar will be also attended by other universities of the region who have expressed their interest and wider public. The seminar will discuss the recommendations for an effective dissemination of results of the project in the region and in the neighbourhood and develop an efficient optimal scheme of VMML commercialisation and advertising.

Established MICVLs will support pedagogical innovation in number of ways:

(a) One of the main assets of the project is the potential to promote and increase collaboration, empowering the individual as a producer, but at the same time embedding their creative potential in a network of mutual assistance and support;

(b) Virtual simulation packages will be developed to respond to the changed cognitive processes and learning patterns that have evolved due to the ubiquity and widespread use of information and communication technologies;

(c) VSs will upgrade the teaching methods potentially giving rise to new approaches which put the learner more firmly at the centre of the learning process.

The quality assurance (QA) and evaluation of both the process and the outcomes of the project will involve a multiple tier approach. We will meticulously follow the work plan of the project and assess the quality of the outcomes using the Indicators of Progress listed in the Logical Framework Matrix. At the regional level, ENAUs will formally evaluate each other's progress throughout the project mediated by the regional centre at TSU.

The main QA will be provided by the EU staff together with the ENAU teams and will represent an essential part of the management. This will take the form of two annual coordination, management and QC meetings and continuous communication between the members of the Consortium. The

TEMPUS offices will be provided with regular progress reports. In addition, VMML and other VSs will undergo external QA peer reviews.

UoW will coordinate the developmental, managerial, evaluation and dissemination processes. Project coordinator Professor Peter Lydyard and deputy coordinator Dr Nino Porakishvili will be involved in general management of the project. They both have been coordinating several TEMPUS and INTAS projects since 1995 and have extensive experience in international collaboration. Proposed project administrator Ms Maka Bakradze is highly experienced in managing TEMPUS projects.

The project management will be carried out as internal and external management. The backbone of the managerial activities will be built around two formal annual workshops and annual coordination, management and quality control meetings via video-conferencing with the participation of all the members of the consortium led by the coordinator. In between the formal meetings, a continuous contact between the members of the consortium will be maintained through communication via skype, e-mails, faxes and telephone calls.

e-learning and DL based course delivery represent fast developing methods of modern education, and the current generation of students is more receptive of multi-media and IT-based presentations. Hence implementation of this project will serve as a model for future developments which will bring participating universities and other HE institutions in the ENA region to the forefront of contemporary education.

Budget and Cost effectiveness

In order to ensure that the proposed results and objectives are achieved economically, the main strategy of the project coordination team is to clearly describe measurable expected benefits and cost of activities necessary to achieve them. The list of benefits provides a clear description of the intended beneficiaries and expected benefits. Each activity of the project is clearly explained and backed with indicators of progress, measurable outcomes, assumptions and risks. Budget items evidently show allocation of recourse among partners, and these have been calculated with assistance of the IT expert members of the consortium. Equipment of the ENAUs with modern IT technologies, software and computers in strict accordance with the Tempus rules is one of the keys to the project success, since modern IT equipment becomes morally exhausted in less than five years. Allocation of funds is strictly based on the requirements of the TEMPUS program (daily rates, cost of stay etc.), and the contribution of each partner to the project. The budget sections involve the allocation of funds against key project deliverables. These sections set the framework for dealing with the “on budget” part of the objective “on time, on budget and to expectations”. One of the principles underlying the allocation is cost control. This will enable adopting good financial management system by which it will be possible to effectively track expenditure over time and provide early warning of likely overspend /underspend or possible savings. In some cases, expenditure will be a critical indicator of progress.