

**The University for the New Market of Knowledge**  
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**The challenges universities face in a knowledge-rich society**

New communication technologies greatly increase access to knowledge. Telecommunication networks, satellite television, Internet and virtual reality modify processes of communicating knowledge as well as their acquisition. Widespread channels have been created which offer new possibilities for a fully democratic access to training and education. This new potential marks the passage from an information society to a cognitive society. We are going through a social and cultural revolution which challenges traditional, institutional models of schools and universities.

Training courses now available due to new technologies allow for the acquisition of knowledge and skills outside traditional educational facilities. Anyone can learn through telecommunication networks. Faced with these processes for change which increasingly characterize this phase of transformation, educational institutions must constantly innovate subject content, reorganize curricula, decide on new development policies tied to the requirements of a flexible, international job market. At the university level, it is clear that there is a need for university education to carry out a new function, that of continuing education and of developing the instruments and mechanisms necessary to do this.

What attracts individuals today to higher level continuing education courses is not the same as in the period after World War II, when further training allowed one to be promoted to a higher level of the production chain. Nowadays the aim is to rapidly gain specialized skills which will allow one to find a new type of job in a changing system. This requires universities to be able to impart knowledge "just in-time", in constant flux, which they were not set up to do. Apart from changes in contents, it is necessary to rethink teaching and learning models and methods due to the profound modification which new technologies have brought to the new ways of transmitting knowledge. The university, an institution which for years has satisfied the need for higher education, must therefore find new strategies which allow it to respond to new situations and reach new users if it wants to maintain a role fitting to its tradition and potential in cultural and social development.

If universities do not face this challenge, they risk following the same path they did concerning research. In the post-war period, most European universities lost their role as principal producers of knowledge. Applied research was developed mainly in public research institutes and in large industrial plants provided with prestigious laboratories which were often financed by national governments. Research was oriented to the development of products responding to market demands. The sometimes negative consequences of this process are evident.

Going back to education, it is necessary to note that today there are many agencies outside the university which have set up advanced training facilities and organized their own distance teaching systems based on the utilization of new teaching technologies. An analysis of contents and psychopedagogical models of these training courses make it clear, however, that in many cases

training endeavors are not oriented towards developing knowledge and skills in a critical and problematic way.

Thus we have within the information society the development of an extended and open educational and training system with considerable potential but containing high risks as well.

As far as traditional educational facilities are concerned, there is the risk of progressive decay if no profound changes take place. If universities want to maintain a key role in transmitting knowledge they must:

- pinpoint new policies of intervention to respond adequately to training needs through an increase in flexibility;
- redefine their functions to compete in a new context and in the new environment of the information society;
- modify the professional role of teachers;
- compare the parallel and separate programs they have been developing.

In other words, in universities there should be a mechanism for transferring innovation which is comparable in commitment and breadth to what takes place when new technologies are introduced into an enterprise, changing the facilities, production processes and professional skills. Industrial production models have all evolved into new flexible models as a consequence of the use of new technologies. The same evolution should take place in the training system; the rigid division of training paths should be abandoned for a more open and flexible system.

This is the challenge which all educational institutions must face. Universities can successfully respond to this challenge thanks to some of their distinct features: the fact that they are both research and teaching centers can play a key role in order to define new means and ways of communicating knowledge using new information and telecommunication technologies to activate new, flexible, diversified teaching and learning processes. And they can carry this out guaranteeing both quality and freedom in the training process, thanks to the strength of their traditions and independence.

The framework outlined above includes the transformations being brought about and the experience being developed in the construction of new models. It is happening within single universities and between different universities through cooperation programs. In the latter case there is greater potential for planning and creating innovations, starting from the process of involving more than one campus in a common project.

## **The NETTUNO Model**

In Italy the distance university model is represented by the NETTUNO, the Network per l'Università Ovunque, an organizational and didactic model run on a co-operative basis, is a consortium of 34 Italian public universities and the British Open University, supported by major telecommunication companies. The consortium structure allows these universities to play a leading role in the innovation of products, processes and facilities, in improving the flexibility and adaptability of products and in increasing students' autonomy, modifying teachers' functions and evolving facilities which can be utilized either face to face or at a distance. The consortium allows university campuses to maintain their position as leaders in research and knowledge transmission in this new model. Bringing different universities together offers a high-quality pool of human resources and knowledge to select from in a wide variety of sectors. The presence of enterprises gives the world of education the chance to become more closely tied to the world of production by

linking teachers and users and responding to the new continuing education needs of human resources.

Thanks to telecommunication and satellite technologies, which eliminate distances between countries, this model can be extended throughout Europe and elsewhere, enlarging the pool of knowledge and skills, bypassing national boundaries and creating a model of university which gives the opportunity to have the best teachers at the world disposal.

This is the most innovative element, as it involves the best and most open-minded teachers in a joint didactic project.

NETTUNO's organizational model and its facilities (National Center, Organizing Universities, University Technological Centers, Home Work Stations, Technological Poles) allow for a diachronic and synchronic teaching/learning process. Teaching sites are no longer only university classrooms but are open, virtual and real: homes, work places, study centers. Through technologies which allow for the management of the distance teaching process (video libraries, computers, modems, fax, telecommunication links, satellite television, Internet, ISDN, virtual laboratories) these areas, the so-called Technological Poles, act as incubators for innovation in the traditional universities and are also utilized by students and teachers in face-to-face courses.

### **Mixed didactic model**

As has been mentioned beforehand, the start-up of an organizational and structural model has allowed a new pedagogic model to be created that fulfills the requirement of flexibility and that manages to avoid the isolation of the student. This is a mixed model that empowers traditional systems by using a way of teaching unencumbered by spatial-temporal limits, but still maintains direct interaction. The model of distance teaching proposed by NETTUNO considers the distance arrangement that includes activities out of which the student studies alone and activities that use new technologies and activities that make the student interact with other people –either in person or at a distance. With this model, one is able to attain "that difficult synthesis between interaction and independence" (Garito, 1996). The two models are described below:

### **Traditional Method**

- direct interaction with teacher and tutor.
- seminars and practical assignments carried out in the presence of the tutor or teacher.
- meetings for tutors and groups of students held at the Technological Poles.

### **Distance Method**

- teacher's lessons (40 academic hours broadcast over television).
- practice exercises (over the Internet, multimedia software, video and computer conferencing).
- distance tutoring (over the telephone, by video, audio, and computer conferencing, by fax, e-mail, computer forums and chat rooms).

### **Satellite Television**

Satellite television and the Internet are fundamental among the technologies used by NETTUNO. All of the teacher's courses are broadcast on RAI channel 2 and are aired 48 hours a day on two satellite channels RAI NETTUNO SAT 1 and RAI NETTUNO SAT 2 , which the RAI beams from

the EUTELSAT HOT BIRD 2 satellite. There are 280 courses produced by the NETTUNO network for a total of 14000 hours of university video-lessons. Besides the video-lectures, there are didactic books, workbooks, multimedia software and products, and didactic Internet web sites linked to the video-lesson that are used for the distance learning courses.

## **Distance Didactic Model**

### **Traditional Didactic Methods**

By planning different distance teaching and learning activities it was taken into account that distance teaching, through mass media (even allowing for the use of interactive processes) does not solve many students and users' problems with their difficulty in relating to a far, remote, and impersonal structure.

Therefore, in order to prevent such from happening, time and places have been given so the student can take the initiative and take advantage of such direct meetings. In particular, the traditional method provides face-to-face meetings for direct interaction between student and teacher or tutor. Traditional tutoring undoubtedly has the advantage of allowing shortcomings to be dealt with on-the-spot through the relationships teachers and students have established in NETTUNO's University Technological Poles during the course of the lessons. The possibility, on the teacher's part, to ultimately motivate the student by creating a positive and open climate is surely one important element of direct contact. At the same time, the face-to-face method breaks up the student's isolation and permits him or her to "socialize within a group". It also creates opportunities for collaboration, exchange, discussion, and debate with other students.

### **Distance Learning Didactic Methods**

Today, modern technology can bring about "presence at a distance" (through video-conferencing, chat rooms...). NETTUNO puts forth a didactic with a method of teaching/learning that is synchronous (teaching and learning happening at the same time, but not in the same place) and diachronic (training and educational processes that are no longer tied to the same time and place).

### **Diachronic Method**

Above all, it's necessary to underline how this method offers the maximum degree of flexibility. The lack of spatial-temporal limitations allows the student to learn at his/her own rate and at the times that are convenient. The lack of limits of space also allows the student to use didactic materials in every possible context: at home, at work, at the study centers –all based on his or her needs. Therefore, optimal learning is fostered.

Different aspects of learning are included in the diachronic method:

- symbolic-reconstructed learning
- learning by doing
- collaborative learning mediated from written work though supportive technologies

In the first two methods, man and machine interact: the student uses a VCR, satellite television, computer, telecommunication networks, and virtual laboratories. In collaborative learning, interaction takes place not only between person and technology, but also between students and/or teachers. Interaction is carried out through the use of technologies that are based on writing: fax, electronic mail, and discussion groups or forums on the Internet. Overcoming the limits of time and

space, these instruments create the conditions for creating a "virtual community" and for equipping collaborative learning processes over a network which then foster new methods of socialization. The possibility to form relationships at the end of studies is essential because it allows the discussion and clearing up of the many doubts that haven't always been taken fully into account by the teachers and tutors.

## **Synchronous Method**

In the synchronous method, the development of new technologies has brought with it a particularly significant innovation. Telecommunication has made it possible to initiate interaction in real time without needing the participants to be present in the same place. Time unfolds simultaneously for all, but place is no longer a necessary condition. Just like in the case of collaborative learning mediated through writing, interaction happens not only with technology, but also occurs between groups of students, groups of instructors, and between students and instructors. The synchronous method, therefore, allows collaborative learning to be carried out through video-conferencing, conference calls, and Internet chat rooms.

## **New Teaching Models**

The new proposed models imply there's been a change in the traditional standing of university professors; they are no longer privileged providers of knowledge. Professors have had to learn, in fact, to give lessons on television, to plan and complete multimedia products and virtual laboratories; they've had to learn to teach with video-conferencing and to create didactic web sites on the Internet. Professors have had to guide students in the process of learning by one-self using non-traditional tools, methods, and technologies. They have had to create new types of books. These professors have the dual function of teaching on television, but at the same time, supporting learning through telecommunication networks and technologies.

Using a medium like television has brought change in traditional didactic communication. In the new didactic model, professors have been forced to find new ways to explain, sum up, and present their knowledge to a virtual student in such a way that the process of learning becomes critical and reflective. The video-lecture requires special preparation and, in order to take full advantage of the medium's power; the teacher has to work together with technicians and experts in visual language. Every video hour requires from 20 to 30 hours of preparation. The teacher has thus naturally developed new communication skills and has learned how to use new languages for memorizing his/her own research results and for teaching regular, traditional academic courses.

Besides teaching on television, professors have learned to create new kinds of books, multimedia software, and virtual labs linked to the video-lessons. These multimedia products are organized in such a way that they cover the bases of knowledge in different departmental disciplines. They cover methodologies of interactive programs, ways of deepening learning processes, systems for self-grading and systems for comparative evaluations.

Many professors have learned to communicate with students and colleagues live through audio and video conferencing, or in real time through Internet's forums and chat rooms. Practical exercises are worked out from these systems. Also, users can discuss the video-course's contents and talk things out if results are unclear. They can develop collaborative learning, help solve problems and also help overcome those difficulties that distance learning students often run into: difficulties tied to the isolation of self-study and learning. In the televised programs, the teacher teaches interactively; he/she asks the students questions, the students answer, they interact with the instructor and with

each other. The collaborative learning they develop is similar to what comes out of working in groups (what normally results from in-class, face-to-face teaching).

In NETTUNO's didactic system, technology is not inserted passively into the university's didactic activities –as if it were any other type of tool. Rather, technology is an active subject; it has become the teacher's new working tool. Without a doubt, this experience has created much reflection over the ways knowledge is communicated and therefore over the university's didactic. Professors are exposed not only to their students' judgment, but now even more so to the judgment of their colleagues and those who chose to follow their televised lessons and connect to NETTUNO's didactic web sites (the sites where all distance learning course materials are found and where there are forums for discussion of various subjects).

### **New Learning Methods – HERMES GIOTTO**

In the open spaces of learning, students can freely choose to go from theoretical instruction to practical training. They can navigate the large multimedia data -bases in real time, and strike up two-way and interactive communication even at a distance. They themselves can be at the center of the teaching and learning process.

Teaching's open and flexible telecommunication settings allow the NETTUNO model to integrate different languages, to open up new lines of communication, and to permit students to activate the process of active and interactive learning. NETTUNO's didactic model is in constant evolution. For this reason, the Network is involved in many research projects at a European level to test, compare and improve its quality.

The most recent research project, H.E.R.M.E.S. GIOTTO, was instrumental in the opening of Nettuno's new, sophisticated Internet portals.

The research project H.E.R.M.E.S. GIOTTO - High TransfEr Rate Medicine and Education Services by Satellite, founded by E.S.A. European Space Agency with other partners such as TELECOM Italia and TELESPAZIO, aims at defining a new, telematic, open and flexible learning environment where, integrating different languages and technologies, it is possible to offer through Internet complete open and distance learning-teaching environments.

The experimental course is in The History of Mediaeval Art; the entire course, 40 hours of videolessons, is digitilised on the network and, by means of a single lesson entitled "The Problem of Giotto", access is obtained to a true multimedia learning environment where collaborative dynamics are brought into action and the various teaching and learning methods used in distance teaching incorporated, each with its own "language".

In this way it is possible to:

- open up new communication links between students and professors, even from a distance, favouring transition from one-way communication (typical of the early distance- teaching models) to a two-way type;
- use the computer as the system's focal point, on which the contributions of the various media that make it possible to achieve a truly "open" and integrated multimedia system converge. In fact, the computer conveys lessons, virtual laboratories, intelligent libraries, multimedia products, data banks, self-evaluation systems, tutorial assistance, exercises, examination sessions and electronic notice boards directly from the university to the student's desk.

Distance teaching organised in this way furthers the establishment of dynamic virtual spaces or virtual classrooms, which are the best places for promoting collaborative approaches to learning.

In short, the objectives are:

- to achieve a product that is really avant-garde from the technological and educational points of view;
- to develop and stimulate students' critical abilities so that they can verify, investigate and independently interpret what they have learned;
- to develop the ability to move about independently in hyperspace and in different research environments, so as to achieve a better level of learning and understanding of the phenomena;
- to allow better interaction with the teachers - an essential requirement for a good learning process;
- to learn how to use an integrated system that makes it possible, on the one hand, to achieve a high level of interactivity and, on the other, to have access to collaborative learning environments in which the student must interact with others (teachers and/or pupils) and obtain the best advantage in terms of learning and of abilities developed.

The model makes it possible to overcome the physical and temporal limitations imposed by the educational process and enables a rich, dynamic and stimulating "virtual environment" to be created, constituting a new learning context that directly influences perception, attention and memory and develops a new way of thinking.

The general teaching model is specially designed to respect individual differences. The constant feedback uses a friendly style of language and a very carefully prepared graphic interface that employs clear, and not too elaborate, symbolism, to facilitate use of the software with every possible platform and configuration.

The navigation techniques used make it possible to integrate several languages and constitute an "open" information tool, enabling the student to interact with the tool, to construct new knowledge and developing an active, constructive and interactive learning. The communication link between teacher and pupil can be strengthened by varying the characteristics of the images or using animation. The indication of specific anchor points within each subject and non-sequential navigation through the different subjects, although limited to clear hierarchical levels, give ample freedom in the choice of educational approach and, at the same time, ensure that the student does not, due to inexperience, follow paths irrelevant to the achievement of the goal set.

Technological progress, and particularly the increase in the speed of data transmission typical of satellite networks, makes it possible to make the most of this learning environment and to achieve complete and easy integration between the different communication systems characterising the Hermes-Giotto virtual environment.

The "open-sky" University of the Hermes-Giotto project provides access to knowledge through different communication modes, types and forms.

It was decided to represent this environment metaphorically as a starry expanse where the student, accompanied by Hermes, the winged messenger of the gods, can surf on Internet through different virtual learning environments and also get in touch with other people. In this open sky, people teach and people learn and students can move around freely in search of contacts and interaction with others and are guided towards the development of learning processes and the construction of their

own knowledge in a collaborative but personalis way. When students enter one of the learning modes "hosted" in this virtual place, they can cultivate their own personal talents by using the material provided for their educational progress.

## **Learning environments**

The different methods of communicating and knowing are "hosted" in a single environment, a "virtual" environment, where the students can enter one of the four realities to use the facilities provided for the educational path and move coherently from one to the other according to the educational route fixed. Within each environment, each learning mode can be integrated with the others simultaneously and they can be enriched with different potentials, thus producing a multiplier effect on the learning opportunities. The term "multimedia" is thus understood in its most complete sense and the learning activity is structured to avoid dissipation and confusion and to promote the transfer of learning, knowledge and experience in a context where the path, guided by a simple "user interface" is intuitive and easy:

- from the simple to the complex (videolesson and intelligent library);
- from theory to practical projection (learning by doing in a virtual laboratory);
- from guided exercises to research on the World Wide Web (Internet);
- from individual study to interactive dialogue between teachers and students and between teachers (videoconferencing).

### **Digitilised videolessons**

The first environment in the educational path offers two different and independent ways of utilising the course.

#### **Digitalised video course**

The first way allows every user to access the server where the 40 digitilised videolessons of the course in the History of Mediaeval Art are digitilised, select a videolesson and either watch it directly or store it on a magnetic support.

#### **Digitilised videolesson**

The videolesson on the complete hypermedia learning environment, entitled "The problem of Giotto", not only permits the functions already described (stop, forward, back) but also permits others.

The student can stop viewing the lesson at any time and explore other learning environments (Intelligent Library, Internet, and Virtual Laboratory).

### **Intelligent Library**

When students enter the intelligent library environment they can access an intelligent library system (ILS). The purpose of the ILS is to offer users dynamic bibliographic selections related to the matters of interest to them and organised instructively.

The system offers students two types of consultation:

simple consultation: in this case the system provides the student with a readymade package of bibliographic references related to the subject dealt with.

intelligent interrogation: in this second case the intelligent system can supply dynamic bibliographic information relevant to the user's interests. The system can select 500 texts utilising 50 variables.

## **Virtual Laboratory**

The program of the virtual teaching laboratory uses the experience acquired with the "broken paintings work site" in the Upper Basilica of St. Francis of Assisi. The exercise proposed in the virtual laboratory requires trainees-restorers to pass a restoration test consisting of putting two frescoes, depicting the faces of S. Francis and St. Clare, destroyed by the earthquake of 26 September 1997 back together. The virtual restorers work on three-dimensional reconstructions of the fragments that, although arbitrary in some cases, include some of the damage suffered by the frescoes; the operations consist of manipulating the fragments "virtually", using photographs of the pictures of the two Saints as a reference.

In particular, the restoration exercise must be carried out through three different tasks:

- selection of the fragments;
- analysis and restoration of the frescoes' fragments;
- reassembling of the frescoes' fragments. A second virtual restoration test requires trainees-restorers to restore a frescoes fragments on a digitilised image using an electronic brush retouching the damaged colour referring to the coloured near areas and reassembling the existing cracks.

## **Internet Environment**

The Internet environment of the Hermes-Giotto project is designed to perform two main functions:

- an information function;
- an educational function.

## **Educational function**

This didactic portal model represents not only a place where to find updated information or to carry out online exercises, but also a place where knowledge can be shared. On Internet chats and forums are available to create virtual meetings between teachers and students. A place of flexible exchange to facilitate the free expression of ideas, opinions and information, to increase the support between peer, to stimulate the knowledge sharing, where it is possible to bring on new contents and develop new knowledge.

## **Videoconferencing and collaborative learning in Internet**

In order to encourage greater interaction between teachers and students and to promote two-way communication, the Hermes-Giotto project accompanies the hypermedia teaching and learning model, used synchronously, with "educational meetings" by videoconferencing in Internet.

During the videoconference lesson the teacher puts forward theories, makes assumptions, asks questions and invites the pupils to interact with him in order to construct learning in constant

evolution. The students can make their contributions in real time, sharing the responsibility for constructing of new knowledge.

## **Videoconferencing and Evaluation system**

One of the qualifying points of the entire project is comprised of the phase of evaluation, planned by following a teacher/student relationship which is strongly supported by a direct interaction through a videoconferencing system in Internet.

The modality chosen for the dialogue between student and product is that of the Socratic dialogue, in which questions are asked to the student which is directed to the most appropriate answers.

The evaluation in our perspective has different functions:

- a formative function which follows the entire teaching process and furnishes useful feedback to the teacher. In particular the evaluation will be focused on the verification of the achievement of the "partial" objectives that the teacher has set.
- a function of global control. In particular the evaluation other, than the specific contents of the course, will verify the real integration and elaboration of such knowledge in a broader and more comprehensive cognitive matrix in the student.
- a diagnostic function, which tries to highlight the possible gaps and suggests how to remedy them. The diagnosis of these gaps allows us to single out alternative courses offering new stimuli to the student, new information.

## **New NETTUNO Users**

The NETTUNO experience, but also other experiences, allows to outline the changes that are taking place as teacher's functions and students' work are concerned. Starting from the research work carried out by NETTUNO's laboratory, we could also become aware of how students' expectations are changing in making them chose NETTUNO distance university. The results of research work carried on students who enrolled in the academic year 1999-2000, show new types of users: young people aged from 18 to 24, who, even if they could attend traditional university courses, they enrolle to NETTUNO courses because of its study method.

The student looks for a study method that has little to do with the structural and didactic rigidity of the traditional university, and that, in most cases, is scarcely open to innovation; where multimedia is seen as a resource that can be just added to other ones, but which does not bring about an overall redesigning of the didactic methodology. On one hand, following the path shown by distance education, the student discovers and experiences the possibility to attend a study course which is characterised by the integration of multimedia technologies, by distance interaction, by flexibility and adaptability. Its a study method that is based upon new languages. The languages that are used by youths to communicate and to enjoy themselves. Actually, these students can be considered as the main outcome of the telematic and technological evolution that is taking place. They are mostly excited by the new and diversified ways of communicating knowledge.

## **NETTUNO and the Market**

In our days the new economy, for the first time in the history of mankind, makes knowledge possible object of business and the passage from a concept of "immaterial" knowledge to 'material good' a reality. This is among the causes of the wild development of various payment educational programmes in which is often evident the lack of quality and methodologies. The massive use of advertising campaign push consumers to enrolle educational programmes on line with the promise of success which inevitably fails to be realized.

On line courses of the NETTUNO model are held by the major university professors. This guarantees both the quality of all the different courses and, consequently the users as "consumer" of education. Every Professor of the NETTUNO courses in fact, is responsible of the high standard of his programm which must corrispond to the best educational level.

The Network for University Everywhere is the owner of a consistent and qualified archive of universitary courses of different disciplines and advanced technologies for the transmission of the texts. The didactic model used (video lessons and exercises on line, media tutoring, chat sessions and forums) already permits the digitalization necessary to face the international electronic market: this is an aspect which represents a great advantage in comparison to other operators.

## **Conclusion**

The NETTUNO model has been helpful in forming a new educational community that is both real and virtual. This model has already produced important results. It has put into debate traditional models of teaching and learning. The fact that those teachers who created distance courses no longer teach in a traditional way is very significant. Now they play out their teaching role in different ways; in fact, they use languages to communicate knowledge with instruments that are constantly more sophisticated. The new enthusiasm generated by this experiment has had a great influence upon other academic settings and has let us propose the model again on a European level. The success of the model is due to the fact that it was created with the awareness of evolution and flexibility of the process. Teachers and students can use technological innovations by and by as they become available.

By using the different abilities of the varoius universities, an interesting synergy has been created among technology-developing companies and quality program developing universities.

The model offers the university a laboratory in which it is possible to experiment with new teaching methods progressively using a language connected with technological development. The foundations have been laid that will make universities become aware of their new role in the information society.

In this laboratory, NETTUNO followed its own evolutionary process. In a few years it went from the simple use of television and computer to the use of sophisticated telecommunication and satellite technologies. Besides this technological progress, NETTUNO can count on the ability and availability of an ever-growing number of professors capable of using new languages. The contextual availability of technological and human resources allowed us to develop remarkable research activities; it also facilitated the experimentation of different distance teaching models.

These research results allow us to create a concrete model of distance teaching that get people and cultures truly closer together; opens the way for a global system of communication of knowledge that changes our way of life and our learning and thinking systems, thus fostering a series of concrete innovations for the traditional training and educational system.

The physical displacement of teachers and students is virtually replaced by the mobility of ideas. Students and teachers from universities around the world can interact. Culture and knowledge acquire an international dimension giving birth to new knowledge, as well as new values. The University moves under open skies, without boundaries. This is the University of the Future!