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From Knowledge to Wisdom

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# Contents

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# Reinventing University in the 21st Century: The Internet, the "New Buildings" of the Universities and New Psycho-Pedagogic Models

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The existence of an Internet network, external to man, made up by the interconnected digital memories, has completely changed the processes and mechanisms of production and transmission of knowledge, research, and learning, and it has been more and more affecting knowledge communication languages. By now, the Internet has evolved into a global platform, ever richer of contents, and it is actually becoming the main infrastructure for knowledge exchange among people. Creating an infrastructure for the higher education of the 21st century involves adding to the university physical buildings as a technological infrastructure: The Internet, which is an interactive and collective communication place, is based, as its peculiar richness, on the direct involvement of its users in the creation of contents, as well as in their exploitation. Of course, as communication models are based on theoretical applications constructed to use different forms of language (such as the language of information, entertainment, cinema, theatre, printing, radio, television, Internet, etc., as well as to develop learning processes), they must also be used as theoretical models useful to construct methodologies and languages suitable to teach and learn through the technologies. Research work on this issue is constantly evolving along with technological evolution. Moreover, the technological platform of the International Telematic University (UNINETTUNO) includes both virtual laboratories, created to carry out research activity, and computer-based networks with other research laboratories in several countries of the world. This presentation will illustrate the research activities whose results allowed to design and realize the didactic cyberspace of the UNINETTUNO, which is based on a systemic approach and on a new psycho-pedagogic model.

*Keywords:* Internet, e-learning, cyberspace, psycho-pedagogic models, virtual laboratories, globalization, innovation

## Introduction

The existence of an Internet network, external to man, including interconnected memories, deeply changed the processes and mechanisms of knowledge, research, and learning production and transmission. By now, the Internet has evolved into a global platform, ever richer of contents, and it is actually becoming the most important infrastructure for knowledge exchange among people. Creating an infrastructure for the higher education of the 21st century involves adding to the university physical buildings as a technological infrastructure. The Internet, which is an interactive and collective communication place, has its basis, as its

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peculiar richness, the direct involvement of its users in the creation and in the exploitation of contents. Of course, as communication models are based on theoretical applications constructed to use different forms of language (such as the language of information, entertainment, cinema, theatre, press, radio, television, Internet, etc., as well as to develop learning processes), they must also be used as theoretical models useful to construct methodologies and languages suitable to teach and learn through the technologies.

This research work allowed for a continuous monitoring of the potentials of the various technologies in order to connect their development to new knowledge communication models and to be able to rely on a consistent body of theoretical and operational knowledge granting a fair balance among the technological-engineering components and the cognitive, methodological, cultural, and educational components specific of education.

This type of interdisciplinary research is connected to cognitive science, psychology, pedagogy, linguistics, computer science, and engineering. These research teams have already produced epistemological models, strategies of analyzing problems in their respective disciplinary fields that enabled the identification of the complex interrelations existing between communication technologies and cognitive processes. In particular, among technologies and theoretical models on which the implementation of distance teaching and learning processes relies.

Within the research activities, we keep on analyzing:

1. Models of interaction between teachers and students, based on the Socratic Method;
2. Hyper-textual, multi-media, cooperative, and collaborative languages to be connected to the methodologies useful to design and realize distance courses;
3. Languages to teach through video lessons in order to develop cognitive processes and long-term memory;
4. Organizational models for Internet-based educational structures.

These research activities allowed to:

1. Identify the complex interrelations existing among communication technologies, cognitive processes, and educational models;
2. Assess the soundness of the hypotheses applied to the teaching and learning models implemented in the cyberspace of the International Telematic University (UNINETTUNO);
3. Assess the efficiency and effectiveness of the organizational model of the educational structure.

## UNINETTUNO's Didactic Cyberspace

The results of these research works allowed designing and realizing the didactic cyberspace of the UNINETTUNO, based on a systemic approach relying on proved knowledge related to learning theories and on the potentials and development of the technologies leading to a constant evolution of the psycho-pedagogic model. The design and realization of the educational processes are focused on the students and on the learning communities.

The psycho-pedagogic theories being applied are mainly linked to socio-cognitive constructivism and allowed using the Internet to realize constructive and collaborative teaching and learning environments, essentially characterized by:

1. Synchronic and asynchronic interactive and bidirectional communication;
2. Student's active participation in the construction of knowledge.

These theories allowed to realize learning environments structured in such a way as to involve students in the process of knowledge production. Thanks to these theories, four dimensions for the implementation of such learning environments were identified: (a) context; (b) construction; (c) collaboration; and (d) conversation.

In order to achieve a true collaborative construction of knowledge, involving both teachers and students, we realized a specific learning environment where all the members of a class or of learning group can easily compare their interpretations of knowledge and take part in the construction of knowledge.

The conceptual frames of reference are not merely a philosophic question, but they come from practical applications that lead to the development of more specific knowledge and bring changes to the learning theories as well as the development of new technologies.

The learning environments of the didactic cyberspace were organized in such a way as to encourage a collaborative construction of structured knowledge, focused on individual and collective educational tasks. The students communicate their ideas and thoughts, ask questions, and continuously exchange knowledge, which is shared by posting it on forums, wikis, and chats. The students can access various training materials specifically functional to a constructive and collaborative learning. Cooperation is the focal point of every interaction among and with all the actors involved students and teachers. In the cyberspace, the students are continuously stimulated by the professor-tutors to become active constructors of knowledge and to identify the most appropriate paths and tools to achieve their objectives. The acquisition of knowledge is dynamic rather that static, multimedia rather than linear, and systemic rather that systematic. The knowledge, that each student builds, appears as the result of meetings and relations with the professor-tutors within their knowledge virtual space.

The new psycho-pedagogic model is characterized by the shift:

1. From teacher's central role to the student's central role;
2. From knowledge transfer to knowledge creation;
3. From integration between theory and practice;
4. From a passive and competitive learning to an active and collaborative learning.

The interaction between learning theories and technologies is at the basis of the model used to post, in the cyberspace, different types of multi-media and hyper textual training materials including also those linked of real cases simulations. An example is given by the virtual laboratories, in which the students can apply the theories learnt in other learning environments of the cyberspace, where they can handle and interact with virtual objects, formulate, and test hypotheses. In this learning activity, the students, besides being assisted by a human professor-tutor, can also receive the support of automated pedagogical agents. These pedagogical agents illustrate the tasks embedded into the interactive learning environments and enhance their involvement and motivation by supplying constant feedback. The students are continuously stimulated by the system to select their optimal difficulty-level learning path and link it to their past knowledge of the subject.

In the cyberspace, designed according to a systemic approach, several learning environments were included, and in each of them, a training session based on a specific method meant to triggering teaching-learning processes was realized:

1. With the video lesson, we use a symbolic-reconstructive learning model linked to the teaching classic mode and, thank to the links to various kinds of training materials, it is possible to study in a multi-medial and hyper-textual way;

2. With the virtual laboratories, it is possible to check and enhance one's own knowledge and skills according to a "learning-by-doing" mode;

3. With the chats, forums and virtual classrooms, and three-dimensional (3D) environments systems through Web-based meetings, it is possible to promote collaborative learning and share the various steps of the learning process with other students belonging to different linguistic, cultural, political, religious, and social backgrounds.

In each environment, it is possible to simultaneously integrate each single learning mode with the other ones. The learning activity is structured in such a way as to promote the transfer of knowledge according to different modes:

From simple to complex (video lesson and intelligent library);

1. From theory to applicative projection (learning by doing in virtual laboratories);

2. From guided exercises to searching the World Wide Web (Webographies and bibliography);

3. From individual study to interactive dialogue between teacher and students and among students (collaborative learning based on communication tools and synchronic and asynchronic sharing).

## The Interaction in the Virtual Classes

Great importance is attached to the collaborative learning activities that take place through the system of interactive classrooms as well as in the tridimensional worlds of the virtual classrooms on second life available on UNINETTUNO's platform.

The 3D virtual environment, by handling variables, such as space, roles, and interaction among the avatars of actual individuals, creates a setting that is characterized by a strong sense of reality, in which the actual individual-avatar figures out the potentials for interacting with the environment and with the other avatars that are present. The individual is immersed in a new dynamic reality, in which he is not a mere viewer, but a protagonist. The experience made in this reality is highly emotional and is deeply involving; the individual is "attracted" into a new virtual world, which has all the features of the real world.

In the 3D virtual classroom of UNINETTUNO's Island of knowledge, students, and teacher-avatars develop learning processes experimenting a new immersive-collaborative learning dimension. The students use interactive tools; they make practical exercises, mid-term assessment tests, dialogue and learn in a cooperative and collaborative way, and become active constructors of knowledge.

The training provisions envisage a teaching model resembling that of the "flipped-classrooms": Students are led to learn in advance about issues linked to the planned discussion, and then they study the video lessons, the reference texts, books, lecture-notes, articles, and essays, preparing themselves to participate in the debate with the teacher-tutor. In the second phase, the avatars of students and teacher-tutors meet in the 3D virtual world and take their seats in the classroom, in which the avatar of the teacher-tutor asks questions to the avatars of the students in order to assess their skill-level. In this phase, the questions being asked are more important than their relative answers; they represent the basis, on which to start the discussion, or better, the "disputatio". Through the "disputatio"—inspired to the learning model of the medieval universities—they foster a learning process taking origin from dialogue and exchange, they learn from other people and reflect on their own ideas.

Learning becomes a process involving the student in thinking about and conceiving multiple perspectives and viewpoints. In their approach to knowledge, they promote creativity and critical appreciation. It is interaction, dialogue, and exchange, which add value to this type of learning. The 3D environments and other

immersive worlds allow for penetrating into the digital body to perceive oneself no longer as a person sitting before the screen of a personal computer (PC), but actually, as being in a virtual classroom animated by actual teachers and students. In the Island of knowledge debates and conferences among students, experts, and teachers coming from other universities around the world take place. In these virtual spaces, social, entertaining, and recreational aspects are experienced as well.

The utilization of a virtual world and of avatars as representations of one's own virtual body enhances involvement and participation, an essential feature of both educational and social interaction. The 3D virtual world is becoming a more and more interesting tool for uniting the two dimensions: The one that is more linked to education and the one that is more linked to socialization and entertainment. The aspect of social interaction, as a starting element for implementing UNINETTUNO's psycho-pedagogic model, finds a more appropriate environment to develop constructive and collaborative learning processes and socialization processes in 3D virtual classrooms.

## The Virtual Laboratories

In UNINETTUNO's cyberspace, there are also virtual laboratories where the student can put into practice the theoretical principles learnt in the video lessons, starting up a "learning-by-doing" process.

In interactions taking place in virtual laboratories, the student is guided, along his/her learning path, both by an expert teacher-tutor and by an intelligent system. We know that is more difficult to teach somebody to carry on complex assignments in order to become truly skilled, a student is required to learn the abstract working principles as well as learning how to apply these principles into practice. Human mind works better on concrete and specific cases than on abstract data. The strongest learning is the one built by "doing", therefore, making mistakes and correcting them, instead of learning in a mechanical way or passively watching the demonstration made by an expert. The apprenticeship method used in the old craftsman's workshop was an extremely efficient way of teaching complex arts, such as painting, sculpture, or woodcraft, etc. Today, many teaching methods are relatively efficient in transmitting abstract principles, but less effective when it comes to teaching how these principles are applied. For this reason, knowledge and skills usually remain divorced from their use in the real world. As a consequence, motivation to learn is often low and much of what is learnt is quickly forgotten or remains "non-integrated or inert" (Kass, 1996). In order to avoid these problems, the didactic cyberspace contains virtual laboratories and exercises. They are an integral part of the video lessons and allow the student to make a direct connection with the application of the teacher's explanations, whenever necessary.

Through virtual laboratories, we develop new learning models that will tend to shift human cognitive working from the symbolic/re-constructional mode to that of the motor-perception one. Re-constructional-symbolic learning is generally associated to learning processes: reading, understanding, reasoning, induction, deduction, conscious, and self-conscious processing. This can normally happen by studying the texts.

Motor-perceptive learning is associated with practical and hands-on activities: You watch, touch, and modify your behavior; you analyze its results, you try and re-try; the response, the reaction of the object results into knowledge since it is automatically linked to the action that generated it: Which is a "trial-and-error", a "learning-by-doing" process.

The student can reflect on their own experiences, on the theoretical principles that are made operational and easily stored into memory thanks to their problem-solving activity. In virtual laboratories, the learner is

always guided by a system automatic intelligent agent or by an expert-tutor who checks and controls whether the path he/she started allows him/her to build his/her own knowledge and competences. In this environment, the student plays an absolutely active role, even though always under an appropriate guide.

A working environment, if sufficiently rich, can encourage students to explore and learn on their own; however, exploration and activities without guidance can only work in a few limited contexts. In most cases, and in particular, for those skills that require complex learning and involve assignments that are not easy to solve, a student without a guide may have problems in correctly interpreting what happens in a simulation and can test only hypotheses that fit into the categories of knowledge already acquired during past experience. An explicit point of reference is provided by the guide who can get round these difficulties and encourage students to explore theories and hypotheses that they would have otherwise not applied.

UNINETTUNO's virtual laboratories appear as true "learning-by-doing" environments where it is taught how to avoid acquiring unused knowledge, putting knowledge into the context in which it will have to be applied (Lave & Wenger, 1991).

## New Ways to Undertake the Research Activity

UNINETTUNO's technological platform includes virtual laboratories that were designed to carry on research activities: hardware and software packages, tele- and video-conferencing systems, distributed processing, and computer networks with other research laboratories in other countries of the world allow researchers to carry on their research activities by using the Web to exchange data, standardize research protocols, and share materials, equipment, and laboratories.

UNINETTUNO's platform allows to cooperate with other international research centers and teams and to work together at distance. The studies and research works carried on by these teams are divided into different units participating in the realization of complex experiments that required more and more diversified competences that can be found not in one single research center, but in more research centers and universities worldwide. Nowadays, it has become essential for all research laboratories and centers to develop a model of permanent interconnection among different excellence poles and laboratories at global level in order to "get the best from who knows best", to cut down costs, to reduce travels and missions, to share knowledge, and to make assessment before, during, and after the realization of expensive and complex experimentations. An example of what said above is given by the Faculty of Engineering, in which two research teams have been recently set up (their names are "UNINETTUNO-High Energy" and "UNINETTUNO-JEM-EUSO") gathering researcher and lecturers from different places of the world.

More specifically, the PCs set up in UNINETTUNO's premises are connected with the laboratories of the Telescope Array in the State of Utah (USA), of RIKEN (Japan), Wizard team of the University of Tor Vergata (Rome), of the University of Tubingen (Germany), of the laboratory of Lanzou and of the CEA (China), etc. The operation and data collection of some experiments that are being carried on are made directly by UNINETTUNO's processors. Through UNINETTUNO's processors, it is possible to control the tests being carried out on the International Space Station, interact with the astronauts who manage, and check operation parameters and data collection. Professors and researchers have a deep experience in these distance interactions. Through UNINETTUNO's connections available on UNINETTUNO's premises, it is possible to work in constant contact with colleagues of other laboratories—exchanging documents and data—accessing databases

of the most prestigious national and international magazines treating several disciplines, allowing for a constant update of field knowledge and facilitating interdisciplinary interaction and exchanges.

In the research field, the development of an immaterial and interconnected society has been a concrete fact for some time now. Connections with the most important research laboratories across the world are boosting the globalization of science that is redefining the geography itself of research and innovation. Today, innovation is on a global scale and researchers aiming at making new discoveries are more and more interconnected. Thanks to the Web, we no longer work in isolation: The solution of a problem often becomes a collective fact and the international scientific community jointly contributes to its resolution. At present, the dematerialization and delocalization of science are more and more pulling ahead.

## Conclusion

UNINETTUNO's psycho-pedagogic model has soon become a global model acknowledged at international level. Students enrolled to the UNINETTUNO come from 167 different countries of the world. UNINETTUNO actually demonstrated that, in order to build and spread knowledge, thanks to the Internet, borders are uncertain, and frontiers are places of continuity and not of conflicts. Thanks to UNINETTUNO's model, teachers and students across the world can give an appropriate answer to the needs of internationalization of the educational systems in order to be able to prepare the skills required by the labor global markets and help transforming the university into an open system, capable of modernizing itself and integrating all the knowledge available on the Web and achieve a worldwide exchange of knowledge.

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