Veterinaria.com.pt 2010; Vol. 3 Nº 1: e1
(publicado em 08 de Janeiro de 2010)
Disponível em http://www.veterinaria.com.pt/media//DIR_27001/VCP2-1-e1.pdf
ISSN 1647-3019 Veterinaria.com.pt

Information communication technology applied to veterinary education in early XXI century

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Abstract

Veterinary education has profited largely from information communication technology (ICT) advances, mainly, in last two decades. The aims of the present chapter are to describe some important veterinary issues deeply involved with ICTs, their impact and challenges in education field, and the relationships between them and the globalised society. The worldwide Internet use and digital literacy levels importance, regarding veterinary students, teachers and general society perspectives, are reported. Online health and biosciences peer-review and scholar literature quickly increased during the last years. New free or paid accessibility forms were widespread developed. Motivations, constraints and trends of electronic learning are analysed in order to evaluate pedagogical or Institutional and Governmental approaches. Past veterinary and medicine imagery, locally stored, yielded place to Health Computer-Assisted Learning packages and simulation case-based. The Web evolution and advances in wireless and mobile communications associated to biosensor tags or radio-frequency identification technology granted multi-user virtual environments, although in an embryonic veterinary phase. The food chain rastreability and tele-epidemiology, including their real-time monitor and prediction, are also a great ICTs based progress. International regulatory laws accreditation and digital literacy levels improvements, other than technological advances, should be one of the major challenges for veterinary education in a sustainable globalised society.

Keywords
Veterinary Education; Health Informatics; Veterinary Imaging Systems; Online Healthcare; Web-Enabled Veterinary Care; Computer-Based Training; Distance Education; Networked Learning; Virtual Learning

1. Introduction

The rapid development of information communication technology (ICT), in past few years, allowed a revolution in overall education systems, including medicine [77], veterinary medicine [80] and animal production field's involvement [46]. The ICT provides new pedagogical models for under and postgraduate's veterinary students including continuous professional education, e.g. lifelong learning. The ICT advances, in last years, gives news opportunities and challenges for biological scientists and teachers, veterinarians, veterinary technicians, practice managers, veterinary students and veterinary technician students. However, these elementary advances will be closely related with the future ICT development in all global society fields.

The acquisition of skills and competences in veterinary medicine and animal production fields was improved, in last decades, regarding the medical and surgical learning, food animal management, food safety, public health, bioinformatics, genetic, research and many other areas. The ICTs are present, as a tool, in all of these scientific and technical fields. A paradigmatic multidisciplinary example can be done by the newest development of the genomic selection breeding based in thousands of single nucleotide polymorphisms in Ireland. A genomic (DNA- Deoxyribonucleic acid) databank for Irish dairy and beef cattle was developed and the program implementation expected during Spring 2009 [41].

Many students, veterinarian and related professionals adopt, actually, digital devices for data storage, computation and communication. The use of Internet for educational and professional purposes also enhanced their interrelationships with society. The classic use of ancillary digital devises, connected to computers, personal digital assistants and servers for teaching and learning purposes in public and private analytical laboratories and veterinary hospitals was changed to a more active interaction with intra and internet systems. Other than laboratorial and clinical diagnosis of diseases in domestic, exotic and wild animals or hospital organizational models, ICTs are also responsible for new paradigms in animal production regardless food animal safety, public health and environment protection, improved by geospatial information technologies. The concepts of geographic or personal mobility, philosophy discussion, professional formation, commercial services and working groups are now in constant mutation. In next years, their global improvements should be closely related, other than technical advances, with ethical and regulatory performances considering the worldwide economic, policy and governmental differences or widespread problems.

In order to discover these aspects, the present chapter aim to identify some relevant areas of veterinary education using ICTs and to determine the impact of new technologies and challenges in each of them. General society involvement and ethical, regulatory acts and law implications are also considered in relationship with the veterinary fields.

In fact, only the worldwide use of technological development applied to research and learn in all professional fields, according international regulatory directories, can create a sustainable biodiversity for human and animal lives. Enlarged by the global climatic alterations, the prediction, control and surveillance of widespread emergent, epizootic and zoonotic diseases assumes a special relevance for animal production, veterinary and medicine fields.

2. Evolution and historical perspective

In the last two decades of XX century, an improvement of electronic and digital devices use for medical and animal production purposes associated to the networks and computation development were observed in veterinary field. The ICTs were progressively applied in research and teaching veterinary schools and medicine institutes or in enterprises related with these areas. Technological advances, relative decreasing cost of equipments, similitude with human medicine and socioeconomic countries development were some responsible factors for this evolution and their democratization in all veterinary and animal production fields.

Initially, the majority of these medical and instrumental materials including biosensors was, usually, only physically connected to a screen or to other similar output signal viewer for human observation and interpretation. For example, before these two decades, the data of animal and human imaging diagnoses was stored in analogical devices for learning and teacher purposes. However, the videodisc technology, in 1980s/1990s, stimulated and was stimulated by the development of several interactive healthcare centers like the Consortium of North American Veterinary Interactive New Concept Education (CONVINCE) [83].

Around 1990s, personal computers (PCs) were democratized, at least in developed countries, induced by technological advances. The veterinary learning and research was widely enhanced in some fields, using bioinformatics and statistical programs stored in diskette or local drive, but without significant network connections (intra or internet). In 1991, the first 3W online site takes place in the Conseil Européen pour la Recherche Nucléaire (CERN) by Timothy John Berners-Lee (see http://www.w3.org/WWW/).

These facts originated a revolution in veterinary education, similar to other scientific fields, opening the door to Internet 1 and Web 1. Initially, workstations, PCs and laptops were used to access websites primarily text-based by narrowband and dial-up liaisons [28].

In 1994, an experimental free veterinary Web service, the NetVet WebSite (http://netvet.wustl.edu/vet.htm), was launched in order to collect veterinary medicine and animal welfare resources [11]. The contents were not only text based but integrated veterinary imagery [19], like the described in figure 1. This service had a Web based and open access pioneer importance's, in late 1990s, due to the connection to several local veterinary and governmental institutions (universities and government departments), mainly in United States of America (US), Canada, Australia and European countries.

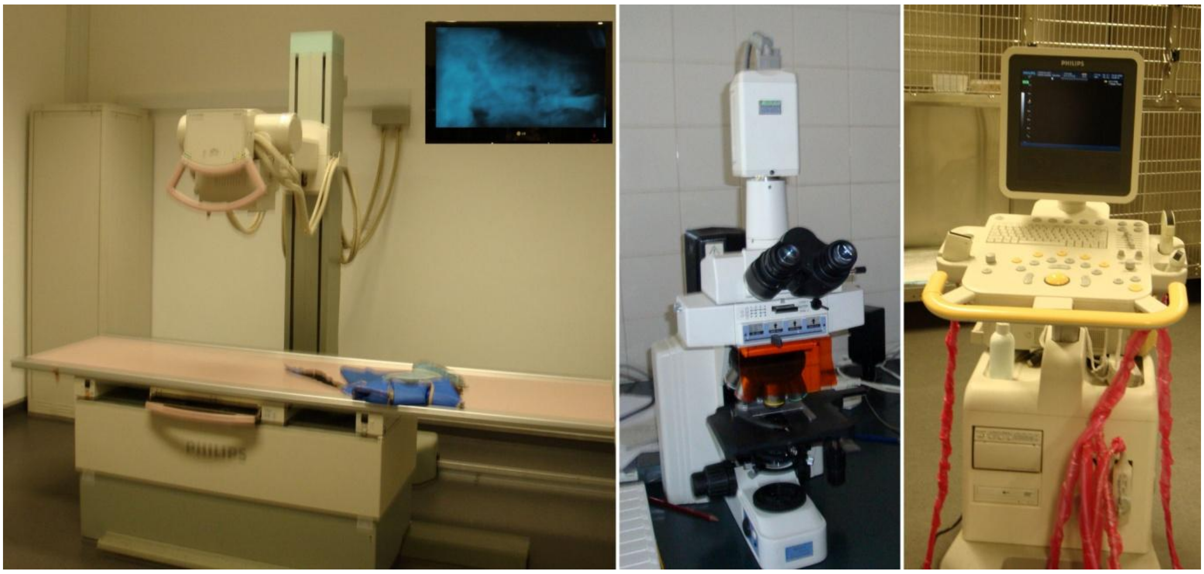

Figure 1. Veterinary Diagnostic Imaging. The democratization, in last years, of electronic and digital devices conceiving digital or digitalized imagery for radiologic (left image), histologic (central image) and echographic (right image) diagnoses in veterinary centers, improved animal care, teacher and learning contents, and decreased costs. Imaging diagnosis was one of the more important pioneer ICTs use in Medicine and Veterinary fields. Many telemedicine services image-based, like echocardiography analysis, were firstly launched according the Web development feasibility.

In this last decade (1990s), hard books or journals and Compact Disc Read - Only Memory (CD-ROM) were the main vehicles for technical and scientific information, preserving copyrights and royalties. Additionally, in the 1994, the Web was also used by commercial librarians in order to buy and share health sciences resources, located on the Internet [35], essentially for scholar and research purposes.

During these years, the veterinary literature and some biomedical software were initially stored in limited digital support distribution like diskettes, CD-ROMs and DVD-ROMs (Digital Video Discs) for data and multimedia uses in classrooms or at home [80]. Progressively, an enhancement to intra and internet server storages was observed, including scientific database search. Every day, more paid or free publications are disseminated, indexed to several scientific and scholar databases, and accessible from the Web.

In fact, the improvement of computing power associated to a quickly evolution of the broadband, greater than 512 KB/s, and structural development toward internet 2 (http://www.internet2.edu/) were achieved. A complex network using various tools to create, aggregate and share dynamic contents was observed throughout these last ten years, and in 2004 the term Web 2.0 was created to refer an emerging social environment, more interactive than the simple Web browser navigation [21].

In 1986, the National Library of Medicine (NLM) of US began the online public domain Visible Human Project® (http://www.nlm.nih.gov/research/visible/visible_human.html) in order to create three-dimensional representations of the normal male and female human bodies. In 1991, the University of Colorado acquired these pixel-based data [1]. Today, the University of Colorado Health Sciences Center (http://www.uchsc.edu/sm/chs/) is a important provider of this technology [7].

More recently, in biology field, the online Cell Centered Database (CCDB; http://donor.ucsd.edu/CCDB/enter.shtml) was created in 2002 with the objective to store high resolution 3D light and electron microscopic images of cells and subcellular structures [57]. Other example, is the Digital Atlas of Video Education project (DAVE; http://daveproject.org/index.cfm) that as an online human medicine gastrointestinal endoscopy video atlas [13].

From 1993 to 1996, the Computer-aided Learning in Veterinary Education (CLIVE), a consortium of six United Kingdom (UK) veterinary schools and 14 international Associate Member Schools was funded by the UK Higher Education Funding Councils' Teaching and Learning Technology Programme [23]. This consortium makes Computer-Assisted Learning (CAL) packages, e.g. biomedical veterinary and templates & multimedia contents, for veterinary undergraduate and postgraduate education, in all subjects of the veterinary curriculum (see http://www.clive.ed.ac.uk).

Around 2000s, some establishments like the Australian Murdoch University stimulated veterinary curriculums advancement in diagnostic imaging veterinary subject. In this University, ICTs enhancements for the correspondent curricular unit contemplated the use of digital interactive images with the Apple’s QuickTime Virtual Reality software, interactive self-tests, submission of assignments, asynchronous discussion of cases and electronic whiteboard [74]. Virtual microscopes, based in slide digitisation and software images viewers, were also introduced in histology and pathology disciplines of medical courses: firstly, in 2000, with intranet-based access at US University of Iowa [39], followed by Leeds University (UK), in 2005, and by Murdoch University [47].

However, electronic learning, also called e-learning or elearning, have different interpretations, and the mobility learning is only a consequence. To clarify this concept, four e-learning dimensions were proposed by Phillips [72]: student - student (individual or social) interactions; student – (present or absent) teacher interactions; student – (traditional or digital based) resource interactions; and student – (passive or interactive) computer interactions. To illustrate these dimensions concepts 3 examples were reported [73]:

1. **Simulation learning object** - the student is likely to work individually and interacts with the computer in presence of teacher and with workbooks;
2. **Corporate training CD-ROM** - the student work individually and is likely to interacts with the computer with digital resources and without the teacher;
3. **Open (university) online course** - students are likely to work socially through networks with passive (only navigation) Web page use.

These online courses or contents were commonly based in the Blackboard Learning System (WebCT; http://www.webct.com/) or the open source Modular Object-Oriented Dynamic Learning Environment (Moodle; http://moodle.org/) based platform.

More recently, the **interactive approach** can be done by simulation technology for teaching and assessment. This technology was progressively increased and is leaderships in health learn and training in human medicine. The contact limitation of students with real case-patient based, quickly health care delivery changes, patient safety improvement, medical errors minimization, and the out-door demonstration of professional competence and clinical safety assessment contributed for this development [77].

At parallel time, the physical and wireless connections of electronic sensors with computers were improved for learn, research [9], public health, animal health cares and commercial purposes. From the last few years, due to automatic identification and data capture, the Radio-Frequency Identification (RFID) technology associated to miniaturized tags can provides continuous or periodical evaluations of biomedical parameters according to the biosensor features. Several training in clinical and chirurgical rooms for animals can take place using these tags [48]. When associated with simulation technology and social networks can represent the onset of Multi-User Virtual Environments (MUVE) interfaces, like the predicted by Dede [24]. In large animals, several studies contributed to food animal chain traceability using these technologies [34,78,84].

Other than RFID technology, the image capture by remote sensing's (satellite images) associated with geographic information systems (GISs) are also used for epidemiological surveillance to predict, monitor and control epizootic diseases in large scale of the globe [76]. Many biological agents of diseases need intermediate hosts or vectors to complete their life cycle and/or infection, respectively. This assumes a greater importance for geographic dissemination of enzootic and zoonotic diseases when climatic changes are considered.

Some dangers and constraints of ICTs use in veterinary education were reported, mainly in research and learning aspects. Short [80] consider that small research and academic centers may do not have capacity to compete with large academic centers or some veterinary practices are difficult to replicate by computers. There are also some evidences of poor digital results due to insufficient technologies development or to different student's impact using new technologies [47]. For example, a novel user interface device was tested by Treanor et al. [86] in order to approach efficiency between optical and virtual microscope for learning purposes.

However, the major problem in all education fields is the internet accessibility and use in different countries, and the digital and linguistic literacy background human population's differences. An interaction and parallel actions face-to-face with different ICTs methodologies for researchers and students [48] may be the response for persons, academic centers and countries with different backgrounds, socioeconomic developments and future aspirations, e.g., the dynamic integration of e-learning, blended learning and, more recently, the t-learning (interactivity associated to the universal digital decoders). The governmental and international cooperation to regulate a global education may be the higher challenge for our civilization. The veterinary education may be only one area, but is the bridge between animal and human health, and to contribute for animal food production and environment preservation.

3. The veterinary higher education and training in the global information society

3.1. The importance of Internet use and digital literacy levels in education: a premise!

The Internet access and use are premises for info-inclusion. According the International Telecommunication Union (see http://www.itu.int/), the worldwide Internet user penetration estimative rate was around 20.2% in 2007. However, 55.4% of users were located in developed regions and 12.8% in developing countries [44]. The figure 2 reports each continent contribution. Major user contributors are located in developed countries of Oceania, American and European continents. This represents a greater handicap for developing countries due to a lack of infrastructures.

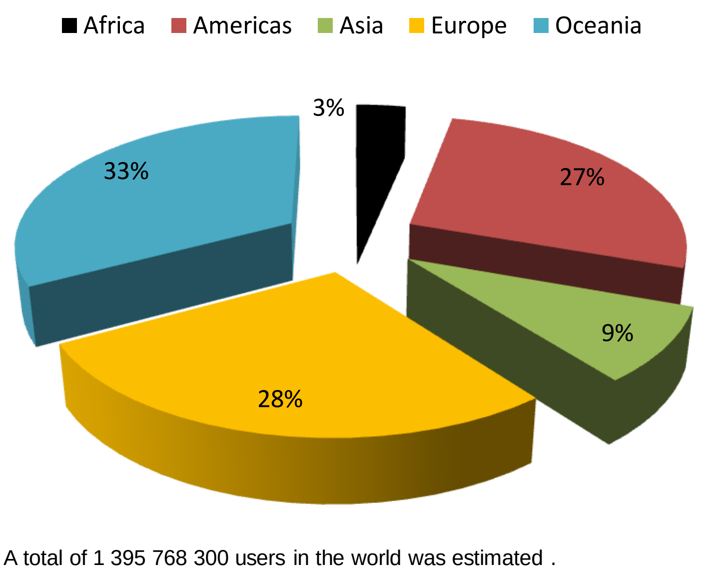

Figure 2. Estimation of Internet users (%) from each continent, in 2007. Data collected from ICT Eye 2007 database (http://www.itu.int/ITU-D/ICTEYE/), on 2009 Mars [43, 45].

Small computer devices and universal mobile telecommunications system (UMTS) creating a global mobile network system, at low acquisition and operational costs, are a feasible solution in these countries for health education purposes [60]. This visionary education project was intended by the non-profit association One Laptop per Child (OLPC; http://laptop.org/). This association was founded by Professor Nicholas Negroponte of Massachusetts Institute of Technology and a core of Media Lab veterans in 2005. Before, in 1980, Negroponte also conceived the MIT Media Lab (http://www.media.mit.edu) in Cambridge, Massachusetts [17], a leading research center in several areas improving, for example, de RFID technology.

The Web accessibility is a necessary but not sufficient condition to profit and create educational tools, and improve the productivity. The digital literacy levels of society are the central point to innovate in a competitive world. In fact, the definition provided by Martin [57] elicit this aspect: "*Digital literacy is the awareness, attitude and ability of individuals to* *appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesise digital resources, construct new knowledge, create media expressions, and communicate with others in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process*" (pp. 135-136).

According to Haasis et al. [36], the ICT sector accounted for almost 50% of the European Union (EU) total productivity upturn, during 2007, with more than 250 million of regular Europeans Internet users. In fact, the Education Audiovisual and Culture Executive Agency (EACEA) was created by European Commission by Decision 2005/56/EC, after the Decision No 2318/2003/EC, in order to reinforce and promote lifelong learning, including essential ICTs programs (http://eacea.ec.europa.eu/index.htm).

Initially, the MINERVA project was created in 2002 by EU, in order to access and preserve the cultural and scientific digitalised documentation. In 2006, this project was enlarged to MINERVA EC with the objective to improve cultural, scientific and scholarly online network contents (http://www.minervaeurope.org) with a probable highly impact in future European education.

In fact, any profession or private and public services can´t apply successfully ICTs without adequate digital literacy levels of their citizens. This is an important problem in developed and developing regions. However, some dilemmas in ICTs use persists in society and in the relationships between citizens and governments, like the described by Dutton and Peltu [28] in table 1.

Table 1. Policy dilemmas in employing ICTs to governments. Modified from Dutton and Peltu [28].

Main tension	Description
Privacy–trust	The Internet's open design that has enabled the user creativity fuelling Web innovations can also undermine trust, safety and security by opening virtual doors to malicious intrusions into citizens' and government's cyberspaces.
Control–freedom	Government needs to maintain some controls to ensure its special position in society is not abused. However, such controls are often seen as intrusive restrictions by citizens.
Central–devolved power	Fear of a loss of control could lead government to present itself as a monolith in cyberspace, rather than allowing each public service to create its own presence within a flexible framework. But devolution could lead to poor coordination, inefficiency and patchy results.
Experimentation–stability	Risk-taking is central to the 'Google generation' spirit, but government must be cautious about the impact of its experiments on citizens and
Speed–deliberation	Instantaneous communication from almost anywhere at any time is accelerating many democratic and government processes in beneficial ways. However, speed can undermine policy making that requires more studied deliberation.
Efficiency–surveillance	ICTs can improve administrative coordination and public services by sharing access to information. But 'Big Brother' fears about abuses of that access can block such sharing.
Protective–enabling	Legislation and regulation aiming to protect against e-network abuses also needs to support as much Web innovation as possible, although that could create new threats as well as delivering new benefits.
Promotion–overhyping	Many citizens need to be encouraged to go online, but over-exaggeration of the benefits of new ICTs and underplaying of the continuing value of other channels can lead to resistance to some innovations.

One of the more interesting interactive social Web services should be the health care provider due to the quality life enhancement importance. Usually, the Internet health access is used for some interactive services like self-help (information) activities, order health products and

interact with Web doctor or other health professional, with or without previously consultation. However, the online patient-provider communication appear remain low.
In US, 6% of Internet users, that had used this service, were estimated in 2001 [6], 7% in 2003 and 10% in 2005 [8]. Baker et al. [6] reported a survey that only 39.7% of US self-reported Internet users, aged 21+, used the Web for advice or information about human health or health care in 2001.
In Germany, this percentage was 27.3% for respondent aged 16+ [42]. Four year after, in 2005, they had grown to 53.1%, but the sample considered people aged between 15 and 80 years [27]. Other survey in seven European countries, reported by Andreassen et al. [4], showed that the health-related use of the Internet, in 2005, was most frequent in the Northern countries. These researchers related 62% health use in Denmark, 59% in Norway, 49% in Germany, 30% in Portugal and 23% in Greece. However, an Internet health use increase between 2005 and 2007 in some of these countries (Denmark: 9.8%; Norway - 6.6%; Germany – 12.2%; Portugal – 9.1%; Greece – 8.9%) were reporter by Kummervold et al. [50].
In EU, the Strategic Project Management Tool-Kit for Creating Digital Literacy Initiatives (SPreaD; http://www.spread-digital-literacy.eu/) was developed between March 2007 and October 2008 with the aim to evaluate and determine policies digital literacy initiatives, especially in learning subject, at regional, national or European level [36]. The early results of this work showed that in some regions the use of ICT is relatively low, especially among adults, and in other regions the digital literacy is widely developed. This discrepancy is important for curricula aspects in order to determine the use of basic and progressive ICTs or innovative technologies such as Web 2.0 or mobile learning. However, a large and active network, with several institutions of same fields, to achieve projects sustainability and reach the target groups is necessary [65].
We empathize that the ICTs application in a specific professional task need a personal technical skill development and competence. However, usually, non-specialized competences in informatics fields should be sufficient for a feasible and profitable professional use, other than the technological advances and general interactivity networks knowledge.

3.2. The organization of scientific and technical veterinary literature in the Web

The electronic digital computers use for publications and online scientific databases literature search had their origin in the second half of XX century. In 1967, the Ohio College Library Center (OCLC) developed a regional computerized system to share resources and reduce academic costs, in US. Actually, this system serves more than 71,000 libraries of all scientific fields in 113 countries and territories around the world (see http://www.oclc.org/). Some years before that, the NLM website (www.nlm.nih.gov/) had explored the use of computers for these purposes and the Medical Literature Analysis and Retrieval System (MEDLARS) was created and evolved to a online system [54,63].
Now, the NLM in collaboration with the National Institutes of Health (NIH; http://www.nih.gov) and National Resource for Molecular Biology Information (NCBI) play, also, an important role for free online biomedical information database search, like the PubMed services (http://www.nih.gov/about/index.html). This database includes over 18 million citations from Medical Literature Analysis and Retrieval System Online (MEDLINE - a largest component of PubMed) and other bioscience articles back to 1948. MEDLINE "is the National Library of Medicine's premier bibliographic database covering the fields of medicine, nursing, dentistry, veterinary medicine, the health care system, and the preclinical sciences" [66]. In NCBI site, other major databases, including the Nucleotide and Protein Sequences, Protein Structures, Complete Genomes and Taxonomy, can be freely accessed.

However, other than governmental databases plays an important role. Today, fifty years after birth (1960), the Institute for Scientific Information (ISI), now called the ISI Web of Knowledge, is the more important commercial online scientific and academic database platform (http://www.webofknowledge.com/), in part due to academic recognition of they scientific journals evaluation. This database service covers all scientific fields and is provided, after 2008, by the Thomson Reuters enterprise (http://www.thomsonreuters.com). The Web of Science, ISI Proceeding, Biological Biosis, Biosis, Previews and Zoological Record (Biosis) are the mains databases incorporating biological, agricultural, and animal and human health fields hosted in the ISI Web of Knowledge. The access to full charged articles is, in part, provided by commercial libraries like ScienceDirect (http://www.sciencedirect.com/; Elsevier, The Netherlands).

Other important science-based but non-profit organization, in these fields, is the CABI (http://www.cabi.org). They story began in early XX century for agricultural development in British Commonwealth. Now, they also develop several animal production and health fields with digital resources from 1970s.

An effort for online free or very low cost access, in developing countries, to these paid scientific journals was performed, in 2000, by the United Nations, using the World Health Organization and Food and Agriculture Organization with the support of Cornell and Yale university libraries [68]. In fact, the Health InterNetwork Access to Research Initiative (HINARI; was launched in 2002 with 1500 journals from 6 major publishers (Blackwell, Elsevier Science, the Harcourt Worldwide STM Group, Wolters Kluwer International Health & Science, Springer Verlag and John Wiley). According to HINARI site (http://www.who.int/hinari/), in 2009, more than 6200 journal titles were available for health institutions in 108 countries. Like this, but in the food, agriculture and environmental sciences fields, the Access to Global Online Research in Agriculture project (AGORA) was launched in 2003. Actually, 1278 journals in institutions of 107 countries are provided by AGORA (http://www.aginternetwork.org/).

In 2006, the public-private consortium Online Access to Research in the Environment (OARE) was created. The main aim was to improve the quality and effectiveness of environmental science research, education and training, also in developing countries and is coordinated by United Nations Environment Programme (UNEP), Yale University and science and technology publishers of several fields (http://www.oaresciences.org).

The Bioline International (http://www.bioline.org.br), a not-for-profit electronic publishing, was launched in 1993 by Brazil and UK (now in association with the University of Toronto) and was pioneer in open access to peer-reviewed bioscience journals of developing countries in the world. Nigeria, Brazil and Iran are the most active countries.

The Scientific Electronic Library Online (SciELO; http://www.scielo.org/) is a corporative model, birth in 1997/1998 Brazil, for free full text peer-review articles of online scientific journal of developing countries with specially incidence in Latin America and Caribbean regions [87]. Their main aim is to prepare, store, disseminate and evaluate scientific literature in electronic format regarding a homogeneous methodology using different languages, with Spanish and Portuguese prevalence. This project was initially developed by the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; http://www.fapesp.br/) with the Latin American and Caribbean Center on Health Sciences Information partnerships (BIREME; http://www.bireme.br). At Mars 2009, they had 612 listed journals from several fields including, agronomy, zootechny, veterinary and medicine. Other main initiatives and database for Ibero-American countries (Spanish, Portuguese and English languages) are the e-Revist@s, founded in 2004-2006 (http://www.erevistas.csic.es/), Redalyc (2002-; http://redalyc.uaemex.mx/) and Latindex (1997-; http://www.latindex.unam.mx/).

For more specific African and Asian continents, other scholar and scientific online libraries were developed. The African Journals OnLine (AJOL) "provides free hosting for over 340 peer-reviewed journals from 25 African countries. These journals cover the full range of academic disciplines with strong sections on health, education, agriculture, science and technology, the environment, and arts and culture" (http://www.ajol.info/). This project was initiated in 1998 by the International Network for the Availability of Scientific Publication (INASP). After two re-launchs (2000 and 2004), he was moved to South Africa, in 2005, as a non-profit-company. In 2004, INASP (http://www.inasp.info) was registered as UK charity after they creation, in 1992, by the International Council for Science (ICSU; http://www.icsu.org/index.php). They are present in Asian, African and also American developing countries with the objective to stimulate the local development as communication, knowledge and networks fields.

Due, in part, to a quickly increase of researches and results, publication accessibility technology and their impact in world development, the open access feasible initiatives (an old concept) surged in last years.

The Budapest Open Access Initiative (BOAI; http://www.soros.org/openaccess/read.shtml) was convened by the philanthropic Open Society Institute (OSI; http://www.soros.org/) in December, 2001. The main aim was to make an international effort with the collaboration of several institutions in order to available free, from internet, research and a scholar articles in all academic fields. Other major initiatives to improve the open access were performed with the Berlin Declaration on Open Access 2003 (http://oa.mpg.de/), Bethesda Statement on Open Access Publishing 2003 (http://www.earlham.edu/~peters/fos/bethesda.htm) and more recently, the Brisbane Declaration on Open Access 2008 for Australian citizens (Brisbane Declaration, 2008).

In agreement with this philosophy, the Directory of Open Access Journals (DOAJ) was launched in May 2003, with 300 journals, in order to increase the visibility and easily use of open access peer-review scientific and scholarly multi-language journals. The DOAJ is hosted and partially funded by Lund University Libraries (http://www.lub.lu.se/). Other important financial resources were or are supplied by the Open Society Institute, Scholarly Publishing and Academic Resources Coalition (SPAR; http://www.arl.org/sparc/), SPARC Europe; http://www.sparceurope.org/) and BIBSAM program of the National Library of Sweden (http://www.kb.se/). On March 24th, 2009, a total of 3940 journals, with 1410 journals searchable at article level and 264 695 articles were included in the DOAJ, according to the home page information. The animal sciences section had, at this time, 57 journals, and that includes the veterinary field.

The PubMed Central (http://www.pubmedcentral.nih.gov/) is a NIH / NCBI / NLM free digital archive of biomedical and life sciences journal literature. The PubMed Central was initiated the public service in February 2000 with publications of the Molecular Biology of the Cell journal (American Society for Cell Biology) and PNAS: Proceedings of the National Academy of Sciences. Now, several hundred other journals (see list at http://publicaccess.nih.gov/submit_process_journals.htm) were directly deposit here. They entire final published version are provided by NIH-funded research, in agreement with NIH [14].

In fact, in 2008, the open access mandate for the NIH [22] began and required that all researches, funded with public (NIH) support, put they per-review accepted manuscripts in an open access form. This mandate directly deposits the manuscripts in an open access repository: the PubMed Central. If these articles were previously published in peer-review journals, embargo permission up to 12 months can be occur. This mandate required compliance with copyright law. NIH retains the right to act in accordance with the NIH policy (http://publicaccess.nih.gov/), even if all the other rights are transferred to the publisher [85]. However, some problems related with US law exclusive rights of copyrights remained polemic, at least until the first semester 2009.

An UK PubMed Central (http://ukpmc.ac.uk/) was also launched in 2007. This free digital archive of biomedical and life sciences journal literature, aimed to mirror the PubMed Central [55]. Similar procedure was adopted by PubMed Central Canada (University of Ottawa; http://uottawa.ca.libguides.com/).

Simultaneousness to PubMed Central, BioMed Central launched the BMC series of journals in May 2000 [40]. This is an UK-based for-profit scientific BioMed Central (http://www.biomedcentral.com) that publish Science, Technology and Medicine (open access) field's journals with a new model, fee by the authors or their institutions, and they retains the copyright. In 2009, 60 journals were published by BioMed Central and the impact factor and other citation-based Scientific Metrics were an important point for them.

Other major open access non-profit, the Public Library of Science (PloS; http://www.plos.org) fully began in 2003 and published, in 2009, a few life and health science journals (PLoS One PLoS Biology, PLoS Medicine, PLoS Computational Biology, PLoS Genetics, PLoS Pathogens and PLoS Neglected Tropical Diseases). However, they also charges a publication fee to be paid by the author or some else (e.g. academic and research institutions).

The Directory of Open Access Repositories (OpenDOAR; http://www.opendoar.org/) is an important directory of academic, local institutional and subject-based repositories. It was initially developed, in 2006, by the Universities of Lund and Nottingham. In April 8 2009, according to they site, OpenDOAR had 1375 repositories managed by the University of Nottingham under SHERPA umbrella (http://www.sherpa.ac.uk). Institutional or departmental repositories (Institutional) represented 80% (1106), cross-institutional subject repository (Disciplinary) 13% (81), aggregating data from several subsidiary repositories (Aggregating) 4% (60) and governmental repository data (Governmental) 2% (8) of total [69].

The Open Archives Initiative (OIA; http://www.openarchives.org/) was developed after 1998, in order to promote interoperability standards for digital contents dissemination. The 2nd version of Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) is actually used to carry these open access repositories and journal literature, e.g. for eScholarship, eLearning, and eScience purposes.

In fact, an important aspect of ICTs use, for publication purpose, is the literature accessibility. The success of this accessibility is confirmed by Pelzer and William [71] that determinate only 6.38% of gray or fugitive literature in twelve core veterinary journals analysis in OCLC during 2000. However, Jack W. Snyder (Associate Director of the NLM between August 25, 2002 and March 2, 2007), considered up to 20% of veterinary gray literature, because it is not indexed in Pubmed or other information services [61]. A primary consensus definition was obtained at the Third International Conference on Grey Literature assumed in Luxembourg in 1997 [30]: ''*Grey literature is that which is produced by government, academies, business, and industries, both in print and electronic formats, but which is not controlled by commercial publishing interests and where publishing is not the primary activity of the organization''* (p. 179).

Actually, the full access to publish in internet tends to decrease this literature type. In fact several free science-specific search engines on the Internet were arising, and thousands of governmental, scientific and scholar accurate web pages were indexed, other than peer-review articles. A System for Information on Grey Literature (SIGLE) was created in 1980 aiming the availability of this literature type in European Community. In 2005, the SIGLE database was transferred to an online open access, on a DSpace platform (http://www.dspace.org/) and renamed the OpenSIGLE that as accessed at http://opensigle.inist.fr/.

The Science.gov project was launched in December 2002 by US government science organizations and the last version (5.0) emerged in 2008. In April 2009, this search engine provided government science information from over 38 databases, involving more than 1950 agencies and 200 million of Web page, via one query, at http://www.science.gov/index.html. The Office of Scientific and Technical Information (OSTI; http://www.osti.gov/) also hosted the WorldWideScience.org, a global science gateway involving over 40 databases and portals from more than 50 countries, launched in June 2007 and accessible from http://worldwidescience.org/indextext.html.

Other free, but privates, scholar and scientific search engines are widespread used. Major Websites are represented by the Google Scholar (http://scholar.google.com/) and Scirus (http://www.scirus.com/).

However, the emergence of online closed community forums and specialized restricted discussion groups of researchers or veterinarian can create new types of gray literature. These new implications and grey literature definitions are largely updated in (annual) International Conferences on Grey Literature (see http://www.textrelease.com and http://www.greynet.org/).

3.3. Constraints and challenges of veterinary e-learning development

The veterinary students and veterinary nurse and technician students´ attitudes toward the "classical" (CD-ROMs based) CALs and their enhancement, regarding international animal-health issues programs, play a fundamental role to future tendencies on professional field. A study, performed by French et al. [32], evidenced that the students' at some veterinary European and US schools, in 2004, considered informative the interactive CD-ROMs fact-based or case-based with parasite database/encyclopaedia and International Animal Health (scenarios from Chile, South Africa and Mexico) contents, respectively. However, any changing students' attitudes toward the international veterinary medicine, in this study, were demonstrated.

With Internet technological advances, veterinarian, veterinary schools or colleges [80] and other institutions are expanding their interactivity with Web sites. In fact, according to Dede [24], in the next years, three complementary technologies interfaces should be present in learning and specific education forms: the classical "world to the desktop" interface, the interfaces for "ubiquitous computing" and ("Alice-in-Wonderland") Multi-User Virtual Environments (MUVE) interfaces (see table 2).

Table 2. Main (predictive) categories for ICTs development in general education and training. Data collected from Dede [24].

Interfaces	Description / Use
"World to the desktop"	The computer desktop providing access to distant experts and archives, enabling collaborations, mentoring relationships and virtual communities-of-practice. The Internet 2 is an important tool for these purposes.
"Ubiquitous computing"	Portable wireless devices infuse virtual resources as we move through the real world. The early stages of "augmented reality" interfaces are characterized by research on the role of "smart objects" and "intelligent contexts" in learning and doing.
"Alice-in-Wonderland" multi-user virtual environments	Participants' avatars interact with computer-based agents and digital artifacts in virtual contexts. The initial stages of studies on shared virtual environments are characterized by advances in Internet games and work in virtual reality.

The interactive veterinary software (using local disks or Web 2) can be applied to case-based scenarios, like heard health management, epidemiological and clinical studies in all animal species or in many other fields. These resources have great advantages for learning and practices training: student´s can take decisions face to a normal, urgent or emergent scenario; no live animals are required, the simulations can be infinitively repeated in any time and any local with different decisions.

The CALs packages can be also authored by students under teacher's staff supervision and can provide a complementation or alternative to classical didactic teaching with more performances examinations results [25].

Obviously, the use of CALs can´t definitively eliminates the animal use for teacher and researcher proposes, but can training students before they use in the classroom or at veterinary hospital. This represents a rational management criterion with a responsible and limited animal use. Consequently, the human ethical behaviour and animal welfare are improved.

Some problems could be finding in these CALs, like the partial capacity to develop and present several probable or improbable scenarios according to the student decisions. Consequently, the full simulation of a dynamic environment, like in real situations may be not possible.

Many CALs created in last decade were based in CD-ROMs storage. However, the quickly interactive and platform technological advances, and the medicine veterinary developments implicate hardware upgrades and software updates for these programs or/and the creation of expensive new programs. For the generality of teachers is not possible to create or modify CALs for curriculums adaptation due to they limited occupational time and skills in this authoring informatics field [25]. To resolve these situations, the RECAL project was founded, at the University of Edinburgh, in order to create a sustainable learning objects approach (http://www.recal.mvm.ed.ac.uk). The process was well described by Dewhurst et al. [25]: the existing CALs are disaggregated into smaller-sized learning independent objects that can be easily reorganized and used by teachers or other personal for pedagogical adaptation. A multitude of veterinary learning scenarios can be created with this methodology. In other hand, students can be stimulated to contribute for the CALs reorganization in other to stimulate their cognition development.

Moreover, the CALs can interact, reinforce or accomplish the mobility students' programs for learning and training purposes. In agreement to the referred above, Erasmus, Erasmus Mundus (2009-2013), Leonardo da Vinci and VETNNET (Veterinary European Transnational Network for Nursing Education and Training) have a great importance in Europe (see http://ec.europa.eu/education/index_en.htm; http://eacea.ec.europa.eu/index.htm; and http://www.vetnnet.com/). An integrated higher education network system is in development in Europe. A European Credit Transfer System (ECTS) was created in order to improve the student's mobility with accreditation [31]. Consequently to Bologna process, mostly veterinary courses opted for a veterinary Masters degree.

However, like in traditional mobility programs students, the linguistics differences between the first and second languages have an important role to literacy skills and competences [18]. In the digital world, that problem persists, but the use of social networking sites associated with mobile digital devices is an important tool to improve cross-linguistic effectiveness [62].

Other than linguistics differences, important positive or negative potential social and economical forces can influence the implementation of scalable and sustainable e-learning academic or scholarship systems. Using social field theories, a general e-learning policy field for the academy was proposed by Parchoma [70]. This author considers two principal potential restraining and four driving vector forces in order to implement a feasible e-learning system (fig. 3).

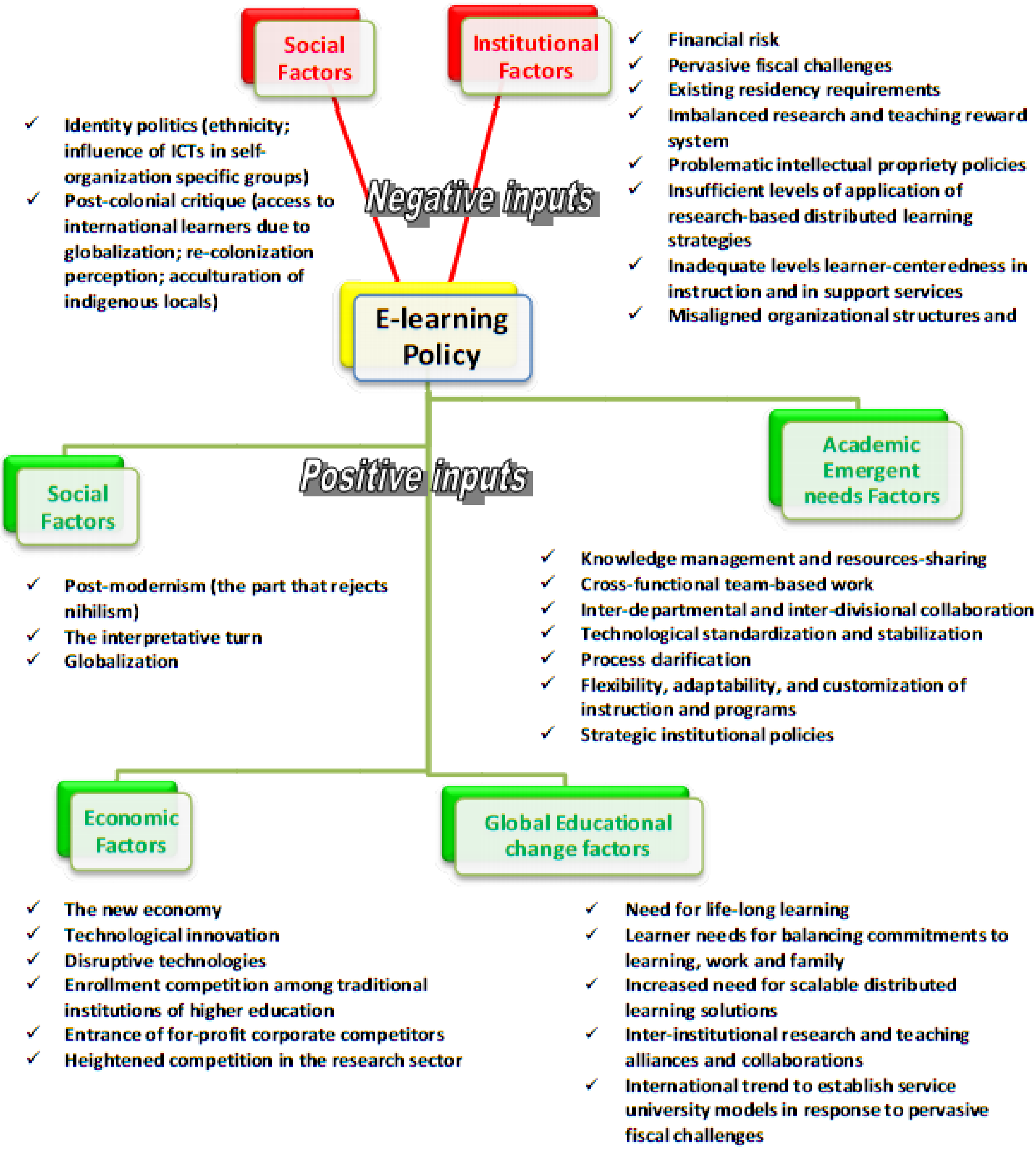

Figure 3. Mains potential positive and negative factors to affect e-learning strategies in academic systems. Modified from Parchoma [70].

In the University of Copenhagen (Denmark), an e-learning platform with access at https://absalon.ku.dk was recently developed with the LIFE (IT Learning Center; http://www.itlc.life.ku.dk/) in other to provide basic clinical skills like small animal's physical examination and basic surgery. The on-line teaching, (face-to-face) video-cases and video-performances were applied in veterinary curriculum. The teachers refers that can dispense more time for a closely and individual student approach and practical classes and make sure, that the students are both theoretically and practically prepared [52].

Similar to related by Ketelhut and Niemi [48] in animal laboratory, ubiquitous computing technology could be also adapted to small and large animals using RFID tags and biosensors for standard operating procedure, in leaning and research activities. Biosensors attached to the animal, for electrocardiogram, blood pressure, and oxygenation / anaesthetic control could monitor the animal motion (fig. 4). This information, other than the pre- intra- and postoperative real-time monitor situation, can be processed and anywhere disseminated by the Web into desktop and portable computers, and other wireless digital devices.

Figure 4. Veterinary operating room for small animals (proposed scenario). Other than biosensor tags to monitor animal anaesthesia during the chirurgical act (central and right up screens), all of this information, including the digital video records (left up screen), can be stored in an intranet server (right server and router) and used for research and learning purposes. Edited or real-time information can be used in classroom, university campus (wireless zone) or at house.

Today, in human medicine, almost all modern medical cares relies on electronic medical devices [5]. These electronic and digital integrative devices allowed the creation of operating rooms like the innovative CIMIT project (http://www.cimit.org/) at Massachusetts General Hospital [53]. For learn and training purpose, they use several simulator types: passive simulators in order to imitate real cases as clinical and chirurgical aspects, and based in anatomic 3-D representations of body parts; active or interactive computer-enhanced mannequins also reproducing normal and pathophysiologic functions; and finally the newly MUVE. Both last two simulator type can be employed for examination, surgical, and endoscopic procedures training and assessment, and evaluated both individual and collaborative skills [77].

However, researches for learning and training procedures are need in order to effective and validate the simulation-based cases, similar to the described by Lammers et al. [51] for emergency medicine in humans. In fact, the (US) Society for Academic Emergency Medicine (http://www.saem.org/) stimulated a consensus group to discuss some trends for the use of simulation in order to develop expertise clinicians: a) teaching strategies optimizations; b) evaluation behaviour of experts in simulation environment; c) high-speed clinician's competence improvement; d) simulation use to manage performance problems, and; e) bridging the gap between simulation and real works [10].

The MUVE can provide an interactive environment, on shared virtual environments, with immediate feedback from interface devices to one or several operators (students or professionals) with different backgrounds, like veterinarian, veterinary nurses, technicians and managers or scientists and teachers. A software for a "Virtual Veterinary Emergency Room" in order to present dynamics and medical scenarios and simulate real situations was developed and proposed by Schlachter [79] in they Master of Science Thesis.

In 2001, a 3D immersive virtual world project - the AET Zone - was launched by the Instructional Technology program at (US) Appalachian State University (http://www.lesn.appstate.edu/aetz/default.htm) in order to create a "social constructivist learning online campus". A new denominated *Presence Pedagogy* (P2) scheme was created (table 3), based in social aspects of teaching and learning, building a true online environment community of practice [16].

Table 3. Tenets of Presence Pedagogy (P2) for education virtual environments. Adapted from Bronack et al. [16].

P2 Principle	P2 Practice
Ask questions and correct misconceptions	• Interactions with faculty and students • Both peers and "experts" serve as catalysts to promote explicit learning
Stimulate background knowledge and expertise	• Activities that require sharing of personal an professional experiences • Recognition of background knowledge and expertise • Acknowledgement of and engagement in a Community of Practice • Cross-course, cross-cohort, cross-program, and cross department interactions
Capitalize on the presence of others	• Activities that promote cross -cohort, -program, and –department interaction • Naming convention to identify student cohort, program, and nationality • Shared faculty responsibility of supporting students across programs
Facilitate interactions and encourage community	• Team teaching • Naming convention to identify faculty and staff • Interdisciplinary lesson/unit planning • Activities to capitalize on notion of Distributed Cognition • Interdisciplinary Community of Practice • Text and voice tools for interaction
Support distributed cognition	• Multiple manifestations of Presence • Creation of open space in which students and faculty of various backgrounds and levels of expertise can interact. • Expertise shared by students and faculty

Share tools and resources	• Students and faculty identification of relevant tools and resources • Availability of tools and resources in shared space open to all students
Encourage exploration and discovery	• Engagement in authentic activity • Creation of open, resource rich environment • Activities that promote exploration of shared tools and knowledge base
Delineate context and goals	• Authentic, action-oriented projects and assignments that have personal meaning and relevance for the students • Visual cues to facilitate organization of and accessibility to tools and resources • Use of avatars and metaphors
Foster reflective practice	• Periodic assignments requiring ongoing, guided reflection • The "So What?" question • Frequent public presentations
Utilize technology to achieve and disseminate results	• Activities that require utilization of in-world tools and resources • Persistent presence of a living curriculum • Multiple presentations across programs, cohorts, courses, and sections

The researches in this, or similar, pedagogical forms will be very important, because can provide experience for human and animal health applications.

Some healthcare professional education examples or experimental projects were reported by Hansen [37]: a) the Advanced Learning and Immersive Virtual Environment (ALIVE) at the University of Southern Queensland (USQ - Australia) stimulate the development of learning contents, using the non-proprietary open AliveX3D program (http://www.alivex3d.org/default.htm); b) the Second Health Project (http://secondhealth.wordpress.com./), based in a detailed hospital comes to life in Second life virtual world (http://secondlife.com/), and developed by the Imperial College in London and the National Physical Lab in UK, and; c) the experiential 3-D learning tool PULSE!! project (http://www.sp.tamucc.edu/pulse/home.asp), funded by the Office of Naval Research and US Congress, aimed learn clinical skills and increase diagnostic thought processes.

In fact, a new paradigm for local, regional and global health interdisciplinary approaches are building due to migrations of people, animals, and germs thought globalization in last two decades. Social or socio-professional networks and professional representations in virtual worlds can contribute to this new worldwide socio-economic statement.

For example, in US, the University of Wisconsin interact between schools of human medicine and public health, nursing, pharmacy or veterinary medicine present in their Madison campus and a division of international studies on major world regions coordinated by an International Health Advisory Committee. Main outcome measures policies and global health core competencies are listed in table 4. The final goal of this Center for Global Health is the creation of an effective and functional Certificate in Global Health as a synergic profit for several countries partnerships [38].

However, several social, economic and legal constrains referred above for worldwide e-learning should be attenuating these health global projects. The international lawful homogeneity will be profitable in order to widespread veterinary and medicine elearning systems.

Table 4. Outcomes measures and core competences for a Global Health Center in University of Wisconsin (UW). Modified from Haq et al. [38].

Categories and criteria for outcome measures	**Educational outcomes**	• Number and location of global health courses and field experiences • Number and types of participants • Graduates with a Certificate in Global Health • Development of a global health track in the UW Masters of Public Health program • Course evaluations by students, UW–Madison faculty, and international partner
	Research outcomes	• Number and type of global health research projects • Number and types of participants (on campus and abroad) • Research funding • Research findings, outcomes, and health impacts • Publications and presentations
	Partnerships service projects exchanges	• Number and locations of international partnerships • Feedback and evaluation from international partners • Number and categories of affiliates • Feedback from affiliates regarding the value of the UW–Madison Center for Global Health • Number and type of service projects and exchanges • Funding generated to support global health efforts • Health outcomes for target populations (before and after interventions
	Administrative outcomes	• Assessment of program and activities by participating units • Feedback from steering committee members • Financial self-sufficiency
Core Competencies	**Knowledge**	• Describe complex determinants of health • Recognize human–animal–environment interactions that affect health • Access evidence-based information on the epidemiology of health and disease • Identify population-based strategies for health promotion and disease prevention • Describe the organization and basic features of health care systems • Describe the roles and functions of nongovernmental organizations in health care • Discuss diverse belief systems as they relate to health • Explain the relationship between health and human rights • Adhere to ethical practice regardless of context
	Communications kills	• Use active listening and communicate effectively in diverse settings • Collaborate and form interdisciplinary partnerships to promote health • Demonstrate humility and engage in effective conflict resolution
	Attitudes	• Promote equity and access to health care for all • Appreciate diversity and promote health across cultures and health belief systems • Demonstrate professionalism regardless of context • Appreciate contributions of various disciplines to health • Exhibit flexibility and accommodation to a variety of circumstances • Value sustainable solutions to promote health now and for generations to follow

3.4. Animal production, veterinary epidemiology and diseases control

In animal production and for commercial purpose, the individual electronic identification of livestock animal has special importance in the chain food traceability due to food safety and public health controls. This identification type also can provide a simple and quickly system to identify each live animal during zoothecnic or sanitary and clinical veterinary interventions. In US, the National Animal Identification System (http://animalid.aphis.usda.gov/nais/) recommends the utilization of International Standards Organization devices compliant (ISO 11784 and 11785 norms; http://www.iso.org) in cows and other food animals. These ear tags low frequency electronic identification device are relatively inexpensive, but read-only [84].

In EU, similar procedures were developed, and an effort to RFID use in several species was make in order to prevent epizootic diseases and food safety in livestock animals or public health problems in dogs. Additionally, the ISO 3166 norm defines the Country Code for each Member State. The Regulation (EC) No 21/2004, EU Commission Decision 2006/968/CE of 15 December 2006, Regulation (EC) No 1560/2007 and Regulation (EC) No 933/2008 provide conditions and laws in order to disseminate RFID use in small ruminants, until 2010/2012. The possibility to use electronic identification in bovines was described in the COM/2005/0009 Report [29] and in equines born after 2009, in Council Directive 90/426 of 26 June. In swine's, some studies for electronic ear tags and subcutaneous transponders comparison were performed [34]. In pets, the Regulation (EC) Nº 998/2003 of 26 May normalizes the subcutaneous transponders.

The TRAde Control and Expert System (TRACES) was developed by European Union in other to make more efficient the tracing monitor of animal movements and animal products [49], enhancing the existing systems, with electronic online data transfer capacity.

Simultaneously, a rapid ability to examine spatial patterns and processes based in informatics tools was provided by geographic information systems (GIS) and applied to epidemiology researches and diseases surveillance [64]. Geo-references can be done by Cartesian coordinates, administrative tools and other spatial references. In agreement with other variables, like diseases diffusion (incidence and prevalence), factors and geographic risks can be studied or evaluated [67]. They use can provide a spatial (3D) - temporal relation observation and wireless mobile devices can play an important role. The management approach, cost-effective actions and prediction of epizootic diseases can be possible with these technologies [12]. Shared with world network systems, monitor or research programs can take place, like the initiated by the "Integrated Consortium on Ticks and Tick-borne Diseases" (ICTTD-3; European Union funded) on tick-borne diseases with the involvement of 29 countries (http://wwwold.icttd.nl/), and initially with India, Iraq, Iran, China, Central Asia, Bangladesh, and Turkey [2]. In intensive animal production, GISs can be also used in emergency management and nutrient waste disposal [20].

In other hand, the tele-epidemiology consist in the combination between data of earth-orbiting satellites (e.g. vegetation indexes, winds and cloud masses, wave height, rivers and reservoirs water levels) and the collected from animals clinical data [56]. Remote sensing (study of objects without any direct contact, through image capture) and GISs can be used for epidemiological surveillance to predict, monitor and control epizootic diseases in large scale of the globe [76]. An example was the application of remote sensing satellite imaging in East Africa to predict Rift Valley fever in cattle. FAO's Special Programme Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) in agreement with appropriate early warning systems for specific diseases can be effective to predict and control they emergence and dissemination [58].

GIS-driven integrated real-time surveillance pilot (open technology) systems, with online surveillance, are other important tools for animal and human diseases [81]. An Australian example for agronomic field is the Australian Soil Resource Information System (ASRIS) located at http://www.csiro.au/services/ASRIS.html. In human medicine, the online geographic information system (EpiScanGIS), launched in Germany 2006, (http://episcangis.hygiene.uni-wuerzburg.de/) was open source based and monitor the meningococcal disease [75].
All of these technologies applied in real situations are or will be important tools for e-learning and research purposes, integrated control centers, universities and other research institutions.

3.5. General future trends of ICT involving veterinary fields

The future of ICTs in veterinary or any other professional field will be closely related with the Internet and Web changes and their interactions with the global society, international regulations and laws.
The Pew Internet & American Life Project (http://www.pewinternet.org/), which studied the social impact of the internet in US and the world, accomplished an online survey about the future prediction of the Internet at 2020s. The deep interaction between mobility, personal, professional or social factors and the global network was predicted (table 5). However, is probable that legal and ethical forms of ICTs uses will remain a sensible subject associated to a forgiveness or social tolerance lower development [3].

Table 5. Expected future of social, political, and economic impact of the Internet around 2020s in the world. Data collected from Anderson and Rainie [3].

Expectation in Internet development *
The mobile computer device will be the dominant internet connection tool due to universal international standards existence.
User interfaces will offer advanced talk, touch, and typing options. A thought-based interface-neural networks offering mind-controlled human-computer interaction will be also possible. The current architecture of Internet will be improved, but not changed to a new global network. Separated Internet spaces will be created or refined by corporations and governments in order to maintain network control regarding the crime, piracy, terror and other security problems and their consequences naturally improved by an open system.
The division between personal and professional time will tend to disappear due to hyperconnected future with more freedom, flexibility and life enhancements. The challenging of family and social life and increasing of individual stress can be a damaging consequence.
Virtual worlds, mirror worlds and augmented reality will be enhanced with smartphones and GPS, social networks and other technical improvements, including genetic engineering. New opportunities for conferencing, teaching and 3-D modelling can be offer. Adverse effects like increase in violence and obesity, in network dependence (more potential for addiction or overload) and new extensions of the digital divide.
The transparency caused by network processes will increase with the internet and web development, but that will not necessarily yield more personal integrity, social tolerance, or forgiveness. Sharing information can profit people and organizations or can turn them more vulnerable. Personal privacy and reputation concept will be enhanced with ubiquitous information dissemination. Multiple or none digital identities can be created.
Control of intellectual property and they policy regulating will still inaccurate for some situations, in part due to non global agreement. New economic models are need in regard to the service or merchandise commerce and classified as paid content, free offer or exchange.

* The online survey was performed by *Pew Internet & American Life Project* from 1,196 expert participants (578 leading Internet activists, builders and commentators and 618 stakeholders) and is not a randomly study of a representative world sample.

Some of these predictions are dependent of Web 3 evolution: Probably, the semantic (meaning) organizational information will take place using metadata - data about data, e.g. a giant database [33] and an intelligent Web who computers can intercommunicate performing, independently, news tasks.
The Web-based interactivity works of veterinary students, teachers and veterinarian appears to will play a fundamental role for veterinary education. The mobility provided by small wireless devises, as a tool, tends to increase this interactivity. A multitude of CALs and MUVEs can be created according pedagogical purposes.
Consequently, scientific and technical literature accessibility, socio-professional networks development, including in research fields and the shared work will be increased at low cost. This global competition and sharing can contribute for a rational human and natural world's resources.
The prediction, management and control of epizootic and zoonotic diseases can be achieved in large regions of the earth.
Environmental and genotypic animal production optimization, including food safety will be controlled with more accuracy.
Global or international regulatory laws like the professional accreditation and intellectual and proprietary patents uses should be improved. The academic or professional e-learning systems should be articulated according to their local and/or global objectives.
A deep pro-active involvement of developing countries in these knowledge networks will be essential for a sustainable worldwide development [82]. Global consortiums' for specific widespread sanitary or educational problems, under international authorities, like the United Nations, provided by multilateral governments or by international corporations should be improved.

4. Conclusion

The quickly technological digital devices, Web and wireless communications developments created non-imaginable implications in animal, veterinary and medicine fields in the last decade (2000s). The use of technological advances, forced by the global commerce (products and services), easy and low cost communications and professional competition, including in learn and research fields, was effortlessly adopted in these areas, mainly, in developed countries.
The digital scholar, scientific, academic and government literature access about animal production, veterinary and human medicine was quickly growing and worldwide expanded. Moreover, a full open access increasing to this literature type with reasonable copyrights preservation was verified.
The CALs and RECALs are, presently, important tools in other to stimulate veterinarian, students and teachers learning. Simulation case-based and MUVEs projects are in an embryonic stage in the veterinary area and should be developed.
E-leanings systems, regarding the veterinary curricula and new pedagogical forms were idealised and tested. Their feasible applications to distance high health and animal production education are in continuous development. Nevertheless, their accreditation and legal regulatory implications need a worldwide expression.
The globalisation, people, animal and products migrations, intensification of long-term unsustainable animal production created new global challenges for animal and public health. Other than national regulatory laws to implant electronic animal identification and food chain rastreability, these new realities involves newest assessment forms to predict and control diseases applied to a large scale.

However, serious problems of ICTs worldwide use persist. In developing countries without technological structures, a great effort was make in order to provide wireless Web access with low cost computers for information accessibility, but effectiveness results should be needs. The developed countries aimed to improve the digital literacy for their citizens, and several projects were implanted.

Finally, specific regulatory laws in sustainable animal production, veterinary and medicine fields for interactive local and global actions, using ICTs, are one of the more important challenges. In XXI century, the (health) information access will not be the principal barrier. The capacity to understand the consequences of they utilisation should be a critical point for individual persons and human societies, e.g. their digital literacy levels and their innovation aptitude to solve old and new problems.

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