Computer-mediated technology and its impact on health-related education

Ana Maria Ponzio de Azevedo¹, Maria Isabel Timm², Helena Hubert Silva³, Carolina Sturm Trindade⁴, Adriana Bos-Mikich⁵, and Roberto C. Thaddeu⁶

¹ Department of Basic Sciences for Health, Federal University of Health Sciences (UFCS), anzevedo@ufcspa.edu.br
² National Center for supercomputing (CESUP) - Federal University of Rio Grande do Sul (UFRGS), Brazil, beta@cesup.ufrgs.br
³ Department of Pathology and Legal Medicine of UFCSPA, hubert@ufcspa.edu.br
⁴ Department of Education and Information on Health da UFCSPA, carolina@ufcspa.edu.br
⁵ Department of Science morphological, the Institute of Basic Sciences for Health (ICBS), the UFRGS, adriana.bosnikich@gmail.com
⁶ Department of Pharmacology of ICBS-UFRGS farmaco@ufrgs.br

Abstract: This paper reviews several examples of the use of computer-mediated technologies in the teaching of health-related fields, contextualizing them in terms of their contribution to various goals. It relates such uses to desirable skills, competencies and attitudes in the profile of these professionals in the XXI century. It discusses the importance of knowing the potentialities of each technology, so as to plan and optimize their use with clear objectives in educational projects for health areas.

Keywords: Classroom Teaching/Practice, Computer Assisted Instruction, Video-Conferencing, Games, Integration of ICT

1. Introduction: The hard choice between so many technological options

The health areas, such as medicine, physical therapy, biomedicine among others, cannot do anymore without computerized technological resources, whether these are hardware, software, or their byproducts, which today are part and parcel of classrooms, cell phones, cameras, sensors, etc., to ensure good diagnoses, quality processes and procedures, macro and microscopic visualization, access to large databases, among the many functionalities that mark the daily professional life. The formation of the professionals who will work in these areas is not the same anymore either. Students and professors interact through virtual and
videoconference settings, minimizing boundaries and overcoming cultural and economic hurdles. They resort to multimedia tools that expand the representational limits of the old technical drawings, fermenting the imagination and reasoning. And together they find means to access and represent knowledge in multiple ways, be it playful, interactive or collaborative or whatever the many other qualifications that are redefining the contemporary educational ecosystem. New terms begin to appear in the professors’ jargon, who now see themselves busy with tools, hypertexts, links, chats and wikis, as well as software versions, processors’ power, browser updating, and plug-ins. All these determine a new virtual space, which for the last years has expanded even more, with cell phones accessing content with audio and video capabilities through the Internet, making the so-called pervasive computation (that accompanies the user everywhere, from the car to the work to the cell phone, connecting them all) a reality.

With so many novelties and options, the main difficulty may be exactly what to use and when, for which purposes, to meet which aims. Margaret Cox and Gail Marshall (2007) ask about the impact of information technology as applied to educational needs: “(...) do we know what we should know?” With curiosity and scientific discipline, the professors of health areas can contribute to fertilize the terrain of the new research area, raising hypotheses related to the use of specific technologies, to be used at definite moments during each course. This is the aim of the present article, which describes examples of the use of computer-mediated educational technologies, pointing potentialities and limitations, as well as planning needs, clear definition of aims, and embedding in didactical-pedagogical projects, of multiple teaching-learning techniques, practices and strategies. Hopefully, this will help to provide teachers with a consistent rationale about what, how, when and why to use, i.e., which technologies are appropriate to the characteristics one wishes to promote in the health area students and how to potentialize their use. Hopefully this will also help us understand how the professional profile, the needs in the health area as well as those of each individual condition the choice for one or other technological resource.

Below we describe a number of cases of the use of technology, trying to explore the aims of the professors and the results obtained, as well the context in which they were applied, in the area of health professionals education. Specifically, we describe: (a) the use of videoconference for debating clinical cases with American universities; (b) the use of distance teaching for formation and qualification; (c) the use of concept maps as a tool of knowledge representation and evaluation; (d) the use of a virtual game for teaching biochemistry; and (e) use of videos.

2. Videoconference: forming world citizens

Videoconference, a technology that allows two or multiple remote participants to communicate audiovisually, is a sort of maximum desire object for teachers who
want to implement courses or events over distance, the interlocutors keeping and receiving each other’s direct looks in real time, just like it happens in classrooms or audiences in traditional conferences. Associated with file exchange resources, videoconferencing permits cooperation between professionals, who can exchange ideas, texts, videos, pictures, etc., whether they are retrieved from storage or produced in real time. Large hospitals and clinical centers already use this resource to discuss cases, qualify students, follow surgeries or even allow surgeons to guide operations remotely. In this sense, it is a resource that must be included in the formation of prospective health professionals, not only for the sake of their professional qualification during the faculty, but also to prepare them for an irreversible trend in the professional market. Moreover, this obliges future physicians to learn to think as citizens of the world, whether because it imposes the exercise of a foreign language or because they need to master new terms, technologies, procedures and a whole body of the professional culture from other countries, their similarities and differences with their own country and, with this, to develop a cognitive space of flexibility and permanent learning. The access to this type of resource in higher education sows in the professional the necessary view that their knowledge is partial, temporary and contextualized, valuing the continued and complementary education, which itself will be able to be accessed through the new virtual world, with distance courses, autonomous research in Internet databases, commercial videos and so many other resources. Below we report a case of videoconference use, illustrating this reflection.

An international experience of this kind of technology was implemented in the Discipline of Coloproctology of the University of Health Sciences of Porto Alegre (UFCSPA) and in the Coloproctology Service of the Santa Casa Hospital Complex of Porto Alegre, in partnership with the Presbyterian Hospital of NY. The didactical periodic use of videoconference was made possible by the contact between the professor of the discipline and the international partners during international events and during his training in the Presbyterian Hospital, where he got acquainted with the culture of remote discussion of clinical cases. After email exchanges and familiarization with the equipment installed in the UFCSPA, videoconferences have been held weekly, with the duration of one hour and mean attendance of 30 people (Cruz et al., 2008).

Some difficulties – which characterize the use of videoconference in general – had to be overcome. One of them was the need for flexibilization of agendas in order to make them compatible with the different time zones of the other centers and ensure higher student attendance, who experienced clash with other discipline’s scheduled class hours. Another serious problem was the understanding of the English language, whose teaching in Brazilian schools, as we know, does not provide the students with the necessary mastery to be able to communicate fluently (in contrast, for example, with European countries). In this sense, the

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1 The videoconference system available in the UFCSPA is a Polycom, Internet connection with up to 6 points.
experience served to highlight the importance of mastering the language and the necessary effort by the students, in order to be able to actively take part in the process.

The course plan is annual and involves lectures, reports, case discussions, and study of the morbidity and mortality rates of colorectal pathologies in each hospital. Along the 12 months, the plan was successfully and uninterruptedly performed with a fairly stable audience across 4 centers. Currently, 4 centers take part in the simultaneous videoconferences: the UFCSPA, the New York Presbyterian Hospital, the Columbia University Medical Center, and the Nyack Hospital, Nyack, NY, with some minor fluctuations due to the difficulties pointed out above.

Some results from the experience can already be noted: participants, physicians, residents and students show a progressive increase in their ability to manage multicultural human relations, creating a propitious environment for the discussion and exchange of ideas and scientific growth. Furthermore, the didactical-pedagogical activity provided the institution with more international credibility through a clear insertion in the medical teaching and practice, in international parameters.

3. Teaching over distance: complementary and continued formation

Distance education (DE) creates an expanded learning space in several areas of knowledge and over the years has become more important as a teaching modality in the health field, both to structure traditional undergraduate courses and disciplines and to support the greater need for complementary and continued formation of professionals, considering the fast rate at which knowledge is increasing and being disseminated, making it obsolete the notion that a simple degree enables the student for the professional practice in any area, particularly in the health field. The DE Nucleus of the University of Health Sciences of Porto Alegre (UFSCPA) has developed actions with the intent of disseminating this culture in the institution and, with it, its direct product, i.e. the general improvement of the teaching activities, since the ability to use technologies affects the quality of conventional classes. Once qualified to teach over distance, professors will bring their educational objects, possibly more dynamic, interactive and motivating, to their presential classes. In the UFCSPLA, since 2007, the Modular Object Oriented Distance Learning (Moodle) is available for professors as support for presential or distance classes. Its use is encouraged to facilitate student-professor relationships, making access and participation viable, at any time, through the Internet, to the contents and forums previously or subsequently worked in the academic disciplines.

Among the results already observed from the use of Moodle, we can cite the greatest precision and agility in sending data to students; interaction between
student groups and the professor; effective possibility of student participation in discussion forums; access to ongoing or already performed work collections; concentration of access to contents in a single virtual environment, facilitating the execution of tasks of the different groups; and making student participation and learning easier. The DE Nucleus, responding to the Introduction to Teaching Program proposed by the UFCSPA (PID-UFCSPA), developed and implemented the Undergraduate Teaching Project of the Distance Education for Integrated Health (PIDEaD), in which the students are supervised by professors, members of the DE nucleus, to develop activities that directly encompass the teaching, extension and research in DE, producing knowledge and exercising specific competencies for the technological environment of the DE.

As a general evaluation of the institution’s initiative, it has been considered that through the PIDEaD, the UFCSPA implemented integrated actions that have had a direct impact on several areas and segments of the contemporary educational management. Through the formation of human resources in DE, it has produced an updating of the technological culture en general, which affects all levels of learning, research and extension. Through the teaching and research projects in this area, it demonstrates a strategic view in terms of management and planning of the future of the institution, which by necessity depends on knowledge, efficient use and dissemination of resources available in the modern educational technology, on the level demanded by the professional exercise of health areas. Finally, as a direct result, we cite the extension courses over distance, which characterize the promotion of health for the external community, the amplification of educational opportunities and the identification of the UFCSPA image with the highest standards of educational policy, promoting access to knowledge in a multidisciplinary, participatory, interactive, and accessible fashion.

4. Concept maps are resources of organization, expression and self-evaluation

Developed from David Ausubel’s cognitive theory of learning (Ausubel, 1980), concept maps are a didactical-pedagogical resource, as well as a study support tool, which have received important recognition of the contemporary research community as efficient tools in the teaching-learning process, for both professors and students. Its use has been disseminated over the last years, usually (but not necessarily) in association with computerized technologies of education. The main foundation of a concept map is to allow its author – a professor or student – to express in orderly fashion the concepts that constitute a given body of information and/or knowledge. This is expected to facilitate the awareness of the cognitive

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2 The students receive a scholarship of incentive to teaching, whose value is equal to the a Scientific Initiation Scholarship of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).
process of organization of ideas, in a hierarchical or simply inter-related fashion. In addition, it’s expected that the map’s author will adding new connections to his/her previous knowledge, thus producing what Ausubel (Ausubel, 1980) called significant knowledge, because it is structured from the relation between new and old conceptual structures. Basically, these are charts constituted of knots (concepts) connected by links that define or characterize the relation between concepts (Moreira, 1988). Its use, made easier by the existence of software like Cmap Tools (available at http://cmap.ihmc.us/conceptmap.html), allows the professors to monitor the cognitive development of students (visible by the presence of new knots) and its complexity (identifiable by the maintenance or change in the level of the relations between the concepts), which can be perceived by the student himself/herself, characterizing a self-evaluation process.

Experiments using concept maps were carried out with students of the biomedical area, in the disciplines of Biochemistry and Forensic Medicine in the UFCSPA. In the discipline of Biochemistry, the concept maps were used to organize relations between concepts that integrate the content of a single class and of a single study unit, and as tools in the representation of knowledge to support the expression of students and even of the professor. In the beginning of the term, the students of the Medicine course were asked to build, first individually and then in groups, a concept map representing their knowledge of Biochemistry. In constructing this concept map, the students could represent through concepts and their relations the purpose of the study of Biochemistry and its connection with the medical practice, increasing their interest and motivation for studying this discipline.

The concept map was also used as a way of presenting the educational software eMetabolism: Glucides and as a tool for evaluating students’ learning with the use of educational software. About 100 students took part in this activity and drew three maps each. Through the analysis of concepts and the linking sentences built by the students, the researchers intended to, first, check the students’ knowledge about the studied content, then the effect of using the educational software and, lastly, how the student would represent his knowledge two months after the study had been performed. In the final evaluation, besides drawing the concept map, the students were also submitted to a written test. The interpretation of the results corroborates the idea that the maps really express the students’ ability of mental representation, as there was a coincidence between the difficulty presented in the written test and the absence of the theme in the concept maps. Moreover, it reinforces the appropriateness of using concept maps as tools to monitor student development (Azevedo et al., 2005).

A second experience of the use of concept maps was performed to deal with thematic modules about themes of forensic medicine, body lesions, thanatology, forensic anthropology, drunkenness, asphyxia, and forensic sexology. Previous maps were drawn by the scholarship students of the Program of Initiation to Teaching (PID-UFCSPA) of the Discipline of Forensic Medicine (PID Legal Medicine), leaving blanks so that the students could use the maps as an exercise to
test their learning. The development of these maps resulted in an alternative tool for learning in this discipline, the foundation being the promotion of active learning and the integration of theoretical contents. The students interacted with relevant and inclusive concepts and the exercise contributed to the differentiation, development and stability of concepts. Some students not only performed the proposed task but also drew their own concept maps enriching them with colored graphic alternatives and a different layout, becoming pro-active learners. Others reported that the resource provided them with an alternative way of studying, either in group or individually, supporting the availability of the tool. The use of computer-mediated concept maps as a pedagogical strategy allows the educator to propose new challenges in the teaching-learning process, in which, according to Ausubel (1980), concepts that apparently are similar for two individuals prove to be different when the maps are drawn and the differences begin to become explicit, something vital in health areas.

5. Educational games are a playful option for dull themes

The content of Biochemistry – like others of the basic areas of health sciences – is particularly difficult for the student, as it demands mastery of abstract concepts and previous knowledge on the properties of substances present in the living organism. Usually the classes in these disciplines demand visual resources to represent the reactions that occur in the cell on a microscopic level and are thus unobservable. From a didactical point of view, in presenting this content, the professor needs to make visual representations of the reactions that occur in the cell. Historically this was done through technical drawings, which tried to imitate the dynamic of the cell process, often with imprecise and inconsistent results. Multimedia resources expanded this capability, giving the professor a huge and flexible set of modes of representation, with multiple means of access and degrees of interactivity, such as animations, videos and games.

In order to facilitate the understanding of the metabolic routes and student interaction with these complex, abstract contents, thus supporting their learning, a study setting called e.Metabolismo (http://dmdv.ufcspa.edu.br) was implemented. This is a software that allows the user to learn, study, and review contents about the metabolism of glucides, through texts, interaction with the professor and, mainly, interactive games with the sequence of substrates and enzymes of the metabolic routes. A preliminary version of the software was developed in C++ (Azevedo, 2003a). The current version of the software was developed in the JAVA platform with the complementary data and records stored remotely in a relational data bank. The system is made available through an applet interface and can be accessed with any browser at http://dmdv.ufcspa.edu.br/. The software was evaluated by two groups of students. The first comprised 11 monitors of Biochemistry. These students had a previous knowledge of the content, and the aim was to test the functioning of the software. The analysis of the results showed
that students and monitors felt the program was easy to use (about 91% of approval), this being the feature with the highest score, and the two features that scored the least (78.5% of approval) were the quantity of information per screen and reversion of actions. From the results obtained, the software was considered navigable, accessible and operational (Azevedo, 2003b).

The second group of this experiment comprised students regularly enrolled in the Discipline of Biochemistry of the UFCSPA, and was designed to check if the software improved their learning. The analysis of the data stored in the setting, the comparison with concept maps built by the students before and after using the software, and the results of written tests of the discipline indicate not only that the software is operational, but also that its use constitutes an activity that can represent an efficient didactical-pedagogical tool for student learning. As a whole, the described project was also characterized by the opportunity of applying theoretical concepts related to Jean Piaget’s genetic epistemology, to practical situations of didactical-pedagogical nature, pointing to future research in the areas of computer-based education and its application to the teaching of science and technology (Azevedo et al., 2008).

6. Videos support visualization

Educational videos also play an important role in the ability of the professor to represent knowledge and provide the students with compelling, motivating explanations about the complex phenomena of the health science areas, particularly for visualization of phenomena that occur in non-reproducible situations – like surgeries or dissections – or highly abstract ones, like microscopic, chemical or molecular phenomena. Videos are an important didactical-pedagogical resource, whose production was facilitated through computer tools and increasingly disseminated through the Internet, in public collections (like You Tube) or in virtual learning environments (Timm et al., 2008). Associated with other multimedia resources, clinical cases and data bases, tools of synchronous and asynchronous debate (chats and forums), research and interactivity, among other elements of access to information and support to communication and interactivity (Schmait et al., 2006), the videos are characterized as some of the most important resources of the contemporary educational technology.

To illustrate the potential of computerized tools for the production and use of educational videos for medical education, we refer to the research into language reported in Timm et al. (2008). One of these generated a three-video series 3 of Neuro and Psychopharmacology, for disciplines of the Pharmacology, ICBS –

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3 The three titles of the series are: Psicofármacos (action on the central nervous system); Psicofarmacologia experimental (with professor Roberto Thaddeu); and Hipnosedativos (with professor Elaine Elisabetsky)
UFRGS. The series comprises studio-recorded classes, with animated illustrations of several phenomena, such as the transfer of an electrical potential from one neuron to another (pre-synapsis, neurotransmitter release, coupling of receptor molecules in post-synapsis, opening of ion channels for the formation of post-synaptic potentials). This path, which could only be imagined by the students, now can be vividly visualized, thanks to video resources.

Another example of support to visualization was taken from a video class by professor Adriana Bos-Mikich, of the Morphological Sciences Department of the ICBS - UFRGS. The video was produced with chroma-key⁴, a technique widely used in contemporary movies and television, in which images are electronically inserted in the composition of the scenario. Besides the resource proper, which brings a tool of medical practice to the classroom, described in details by the professor, the video included captions (developed follicles) in order to provide an exact visualization of what was being shown. Also as an editing resource, a slide on the same theme that had previously been shown was added to the scene, thus obtaining an abundance of information and an inter-connection of the presented themes and resources, in order to highlight the relevant content.

7. Conclusions

The teaching-learning process in health today can count on powerful tools of representation, computation and communication, made available by the computational culture. As these are part of the culture of the students, they are handled with dexterity, both for leisure and for information in general, and increasingly for research, active learning, collaboration efforts, knowledge construction, and awareness and amplification of their own cognitive resources, as they stimulate reasoning and imagination. In this sense, it is imperative that professors incorporate these resources into their classes in order to support the understanding, motivate and stimulate students, add value to their own work, as it will be structuring a renewable, dynamic and high quality collection.

It is important, however, that every resource be recognized and used by the professors according to their specific characteristics, their potential, and the need for each part of the content, educational project or subject, either for presental or distance activities, in the regular course or in continued education, respecting the conditionings of time, space, technological culture, students levels, and the specific aim of each course. None of these resources, whether software or media, is by itself a complete or definitive answer, and they should be integrated into flexible projects, according to the respective conditionings. The same reasoning must be applied to the decisions concerning the choice of more or less interactivity, more or less dynamism, more or less complexity: these choices depend on the professor and on the student, on the content, on which part of the

⁴ The chroma-key technique is commonly used in weather reports.
content, on the available technology, on the support team for production and use, among the many items that characterize the teaching practice on a professional and institutional scale.

In this article we tried to describe some of these many resources, with distinct uses, so as to sow this knowledge. It is up to the contemporary educator, of the health field and of all other areas, to get to know and learn how to use these technologies, determining what, how and when to use them, for which necessities and to meet which objectives, transforming them in educational and motivating materials. It is suggested that this attitude will, in the log run, produce qualitative modifications in the teaching/learning at all levels, providing the educatee with a flexible, dynamic and critical understanding of the contents of his/her area, and supporting the construction of a logical reasoning in the process of diagnostic evaluation and intervention in health.

References


