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# An educational software development proposal for nursing in neonatal cardiopulmonary resuscitation\*

DESENVOLVIMENTO DE AMBIENTE VIRTUAL DE APRENDIZAGEM EM ENFERMAGEM SOBRE RESSUSCITAÇÃO CARDIORRESPIRATÓRIA EM NEONATOLOGIA

DESARROLLO DE AMBIENTE VIRTUAL DE APRENDIZAJE EN ENFERMERÍA SOBRE RESUCITACIÓN CARDIORRESPIRATORIA EN NEONATOLOGÍA

Rita de Cassia Vieira Rodrigues<sup>1</sup>, Heloisa Helena Ciqueto Peres<sup>2</sup>

## ABSTRACT

The objective of this study was to develop an educational software program for nursing continuing education. This program was intended to incorporate applied methodological research that used the learning management system methodology created by Galvis Panqueva in association with contextualized instructional design for software design. As a result of this study, we created a computerized educational product (CEP) called ENFNET. This study describes all the necessary steps taken during its development. The creation of a CEP demands a great deal of study, dedication and investment as well as the necessity of specialized technical personnel to construct it. At the end of the study, the software was positively evaluated and shown to be a useful strategy to help users in their education, skills development and professional training.

## DESCRIPTORS

Education, nursing  
Educational technology  
Education, distance

## RESUMO

Esta pesquisa metodológica, aplicada, de produção tecnológica teve como objetivo o desenvolvimento de um Ambiente Virtual de Aprendizagem (AVA) para educação continuada em enfermagem sobre ressuscitação cardiorrespiratória em neonatologia. Para a elaboração do ambiente adotou-se a metodologia de Galvis Panqueva associada ao design instrucional contextualizado. O ambiente educacional desenvolvido foi denominado ENFNET. A criação de AVA demanda muito estudo, dedicação e investimento, assim como a necessidade de pessoal técnico especializado para sua elaboração. O ambiente foi avaliado positivamente e mostrou-se útil como estratégia para auxiliar na aprendizagem, no desenvolvimento de habilidades e na capacitação profissional de enfermeiros.

## DESCRIPTORES

Educação em enfermagem  
Tecnologia educacional  
Educação a distância

## RESUMEN

Esta investigación metodológica, aplicada, de producción tecnológica, apuntó a desarrollar un Ambiente Virtual de Aprendizaje (AVA) para capacitación permanente en enfermería sobre resucitación cardiorrespiratoria en neonatología. Para la elaboración del ambiente, se adoptó la metodología de Galvis Panqueva, asociada al diseño institucional contextualizado. El ambiente educativo desarrollado recibió la denominación de ENFNET. La creación de un AVA demanda mucho estudio, dedicación e inversión, así como la necesidad de personal técnico especializado para su programación. El ambiente fue evaluado positivamente y se mostró útil como estrategia para colaborar en el aprendizaje, en el desarrollo de habilidades y en la capacitación profesional de enfermeros.

## DESCRIPTORES

Educación en enfermería  
Tecnología educacional  
Educación a distancia

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## INTRODUCTION

The adoption of new information and communication technologies in education has brought significant changes in the traditional educational paradigm by promoting new forms of teaching and learning, inducing new behaviors in students and teachers, creating new forms of relationships and generating new ways of thinking and producing knowledge.

The use of new technologies in education allows more flexibility in teaching, making it more accurate, dynamic and permeable to the requests and needs of the context in which the student user is located. The creation of effective educational programs depends on how new technologies are employed to accomplish specific goals. It is necessary to learn how to use these technologies correctly and appropriately to develop educational products directed toward the virtual environment.

The development of new teaching practices demands a redefinition of educational theories to modify and render flexible educational structures, institutions and educational actions so that they can adapt to the new standards of a technological society: autonomy, humanism, cooperation, interactivity, training and continuous actualization<sup>(1-2)</sup>.

The creation of a *web-based educational system*<sup>(3)</sup> does not consist only of the scanning of texts or printed materials because *educational computing has its own language, principles, tools and methods (...)*<sup>(3)</sup>, which make the learning management system (LMS) a dynamic and interactive space, present in real-time, closer to the reality of the user and extremely rich because it allows the use of different media features that make the process of teaching and learning more creative, interesting and powerful. We wondered, then, whether an LMS would be an appropriate instrument to convey issues inherent to the field of nursing. How should an online course directed to nursing be built? Given that nursing is essentially a practical profession, which tools should be used?

### ***How could theoretical and practical material be adapted for the virtual world?***

A well-planned LMS should enable the use of various resources for the development of educational activities. The technique, resource or tool to be used will depend on various factors such as the content to be taught, the user's experience with technology and the network resources (broadband or dial-up internet access) available. Thus, the teaching plan can be made within patterns: behaviorist (e.g., exercise and practice), cognitive (e.g., simulation) or socio-constructivist (e.g., discussion groups)<sup>(4)</sup>.

As opposed to traditional classroom learning, the structure and social organization of online teaching is more horizontal and non-linear, considerably increasing the possibility of differentiated communication that is both diversified (synchronous and asynchronous forms) and individualized, promoting dialogic features. In contrast, to act correctly and efficiently in online education, it is necessary that both students and teachers make intense efforts and have digital fluency and command of new techniques. Teachers must also have technological teaching skills related to new forms of content creation and management of the course in the development of teaching situations to encourage group interaction toward successful results in the educational process.

Thus, teaching in virtual environments should be properly planned and based on educational principles that privilege dialogical learning and can contribute to the formation of opinions, reflections and concepts by the participants.

This research aimed to develop and evaluate a learning management system focused on continuing education in nursing.

The creation of effective educational programs depends on how new technologies are employed to accomplish specific goals.

## METHODS

The study was based on applied research into technology production<sup>(5)</sup>, which was adopted because it dealt with the process of developing/creating a new product, activity or service, namely, a learning management system in nursing in which the theme of the test course applied to verify the functionality of the LMS focused on cardiopulmonary resuscitation in neonatology.

This study was approved by the Research Ethics Committee of the University of São Paulo (USP), and it was developed at the School of Nursing at the University of São Paulo (EUSP) in the Department of Vocational Guidance (DVG).

The methodology of Galvis Panqueva was used to create virtual learning environments<sup>(3)</sup> during the development of our LMS because of its clarity and cohesion, making the process more objective. Parallel to the physical development of the LMS, contextualized instructional design<sup>(4)</sup> was employed for the design of the instructional teaching activities. The characteristics of both methods will be described below.

The methodology for creating the LMS comprised five phases<sup>(3)</sup>:

1. *Analysis* – In this phase, the defining of the instructional objectives occurs through analysis of the intended teaching content for the students. The content that should be available and the means to support it are also defined. This analysis should be an evaluation of various aspects related to the target audience such as motivation,

goals, needs, and digital fluency, among others. Aspects related to the tutors, the work/study environment and the technological infrastructure should also be analyzed. The following analysis steps were performed at this stage of the creation of the LMS:

- Characterization of target audience
- Choice of subject
- Definition of educational goals
- Definition of content

Analysis of the technological infrastructure for the development, implementation and maintenance of the LMS

2. *Design* – In this stage, the instructional design is defined, namely, the didactic activities that will be applied in the environment and the choice of the resource used to perform them. Furthermore, the evaluation system, navigation structure and design of the interface or the means by which the students will interact with the system are also provided. The following design steps were performed during this phase:

- Instructional design
- Construction of educational objectives according to Bloom's taxonomy
- Selection of system tools
- Establishment of educational evaluation types that will be used in the LMS
- Design of navigation map of the learning environment
- Interface design to create the first layout in the learning environment and define the elements of the layout

3. *Development* - The development step consists of the realization of all the design steps undertaken during the previous stage through the definition of the programming language, which depends on the proposed virtual environment and the types of media that will be used and the selection of those media (e.g., sound, video, animation and others). The following development steps were performed during this phase:

- Programming, installation and configuration of the LMS on the server of the USP
- Registering a particular domain on the Internet
- Installation and configuration of the LMS in the particular field
- Definition of the software package management that would be used for the development of the learning environment

4. *Evaluation* – In this phase, an evaluation of the whole system developed by the content expert occurs in

addition to an evaluation of the rapid prototype to check the operation of the LMS and perform tests simulating student usage to identify errors. After the initial tests are completed, evaluations of alpha and beta releases are performed that involve performing the final tests with the LMS after the identified errors have been corrected. The following evaluation steps were performed during this phase:

- Evaluation of the content and rapid prototype
- Evaluation of the alpha version
- Correction of the problems found in the alpha version to yield the beta version
- Release of the beta version for evaluation by specialists and students

During this stage, undergraduate nursing students and expert professionals in various fields of knowledge related to nursing, IT and education were invited to evaluate the learning environment. The evaluators comprised a non-probabilistic convenience sample for which selection was performed using non-random, intentional methods<sup>(5)</sup>.

Thus, the sample consisted of 3 students in the third period of Undergraduate Nursing of EEUSP who were attending the module *Health of Women and Children*, 2 computer experts (1 systems analyst and 1 specialist, designer and consultant in distance learning), 1 medical specialist in neonatology, and 3 nurses who were also nursing teachers and/or had expertise or professional experience in neonatal intensive care and IT for nursing.

For data collection, different methods were used for the evaluations by the experts in IT and the other experts and students. The evaluations were divided into three thematic areas, which were developed based on the Ergolist Project and developed jointly with the Laboratory of IT Usability at the University of Santa Catarina, which aims to evaluate the simplicity of using devices with interactive software<sup>(6)</sup>.

5. *Administration* – In this phase, the environment is managed to ensure its correct functioning. Installation and configuration of the system, as well as task management, are performed before the course (preparation of lessons, testing of resources used, registration of students, guidance of students), during the course (information, help and guidance for student activities, evaluations) and after the course (providing certificates, archiving materials and making back-ups). The following administration steps were performed during this phase:

- Frequent checking and maintenance of the operation of the LMS
- Backing-up security copies
- Conducting routine back-up of the activities performed with the LMS.

The software development package *Dreamweaver MX 2004*® by Macromedia was selected to facilitate the construction of the learning environment because it enables the use and integration of different languages and applications<sup>(7)</sup>.

The software was developed using ASP (Active Server Pages) because it is suitable for the creation and use of dynamic content and to integrate Flash MX 2004® to create the animations. This software also allows easy management and maintenance of the content<sup>(8)</sup>.

MySQL was also used, which is an open-source software (free use, unpaid) that can be defined as a management system database. It was necessary to use MySQL in the development of this LMS to provide simultaneous access to the data by multiple users, record the actions of the users, store the results of the students' exercises, operate the questions and answers of the forum, enable the stability and security of the system, retrieve data, perform back-up, and register the use of passwords and identifiers. All of these actions are critical to the proper functioning of a learning environment<sup>(9)</sup>.

The learning environment was programmed in such a way that it could be viewed using different browsers (software programs that allow the viewing of websites on the World Wide Web) and on different platforms (Microsoft®, Macintosh®) without encountering problems.

The use of this methodology as well as the experimentation and handling of other virtual environments were of great help in the construction and development of the LMS in neonatal cardiopulmonary resuscitation. Contextualized instructional design (CID)<sup>(4)</sup> was used in the creation of didactic activities. CID is defined as

(...) intentional and systematic teaching actions, which involve planning, development and the use of methods, techniques, activities, materials, events and educational products in specific teaching situations to facilitate human learning from the principles of known learning and instruction<sup>(4)</sup>.

CID has the specific feature of enabling the structuring, modification and adaptation of the entire process of design construction. The student discovers and absorbs the specificities of the context in which the design develops in a process of continuous information feedback that generates the necessary changes for the learning situation that is being constructed.

CID in online learning uses resources offered by new technologies to compose programs and learning activities through elements such as sounds, images, hypertext, simulations, animations, and audio and video conferencing, among others, which are always supported in virtual environments. These elements harmonize perfectly with the dynamic and recursive character proposed by CID because the educational material in the virtual environment can be constant and readily modified and updated, and

it can be adjusted according to the needs and goals of its participants even during the course.

The steps proposed by CID include the following:<sup>(2,4)</sup>

*Analysis* – In this phase, the identification of learning needs occurs, if there is demand for a theme. The instructional objectives are defined according to the characteristics of the target audience, taking into account environmental, economic, administrative and technical limitations and constraints related to the time available for the course.

*Design and development* – In this phase, the structure and sequence of the content are defined, and the selection of media for the presentation and production of instructional activities takes place. The production of materials determines the degree of interaction for the users and the desired interactivity in the LMS, how the material will be presented, the technical support and the type of tutoring available to the student.

*Implementation* – In this phase, the capabilities of the students to use the developed materials are defined as well as the ambiance of the users in the LMS. In addition, the didactic event is carried out, namely, the verification of the cognitive process, the formation of social relationships in the group, and the evaluation and feedback processes that will be performed by the teacher.

*Evaluation* – In this stage, a review of all of the content is performed to identify and correct errors, and how the design will be evaluated throughout the course for its continuous improvement is defined.

The most important steps for developing an online course are setting objectives, producing suitable reading material and building an efficient and organized roadmap.

## RESULTS

The use of the methodology for creating an LMS<sup>(3)</sup>, in association with contextualized instructional design, resulted in the development of ENFNET, a virtual environment aimed at continuing education in nursing.

ENFNET was designed to be clear and objective but at the same time to have the possibility to add and use various multimedia features. It can be accessed through the address <http://www.ee.usp.br/departamento/enf/neonatal/> using a login and a password after being registered by a tutor. The tools of the system are presented below.

*Program* – The first screen that students access after entering the system provides general information about the course such as presentations, programs, instructional objectives, schedules and ways of communicating with the tutor (Figure 1).





Figure 1- Screen program

**Students** – This is the second menu button. It opens a screen that allows the students to change their passwords, and it displays a text box where the students must enter their goals and expectations upon completion of the course.

**Modules** – This screen contains links to five modules comprising the Course of Neonatal Cardiopulmonary Resuscitation. Hypertexts are built in to be presented in each module using resources such as images, animations and audio, plus the insertion of internal and external links that help students to deepen their knowledge about the topic under study.

**Material** – This screen functions to present the aide materials necessary for the development of the course, such as texts and external links that should be visited and discussed by the students. The material posted on this screen will be added to throughout the course according to the needs and goals of the students.

**Forum** – The forum has the purpose of discussing issues related to the topic under study, and it is an excellent tool to help the socialization of the group (Figure 2).



Figure 2- Screen forum

**Exercises** – This screen shows links to exercises that were designed based on the modules of the course. The exercises include multiple-choice, linking columns and true or false exercises, one simulation, and exercises to be conducted in groups that are aimed at increasing interaction between the participants and encouraging collaborative group work. All of the exercises included in the

LMS receive a score. The score obtained for the exercises in each module is revealed after the student answers all of the questions in that module. Only the first attempt of the student is computed so if he answers wrongly the first time, he does not receive points for that question; however, for didactic purposes, he cannot progress to the next exercise until replying correctly to the question.

**Email** – In this screen, the electronic addresses of all of the members of the course are displayed. This is an indispensable tool in virtual learning environments to facilitate communication between all of the participants and increase group socialization.

**Portfolio** – This section has two functions: one is to publish the student's profile with a brief summary about his goals, personal tastes, and life, and the second is to publish the work produced by the group.

Another feature is a clinical simulation developed as a pedagogical proposal for the LMS to provide participants with the opportunity to experience the care of a newborn in a state of cardiac arrest. The clinical simulation replicates a particular clinical environment, favoring performance, problem solving and decision making<sup>(11)</sup> (Figure 3).

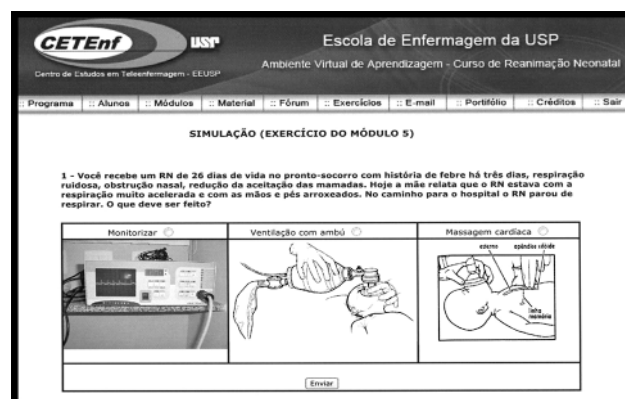


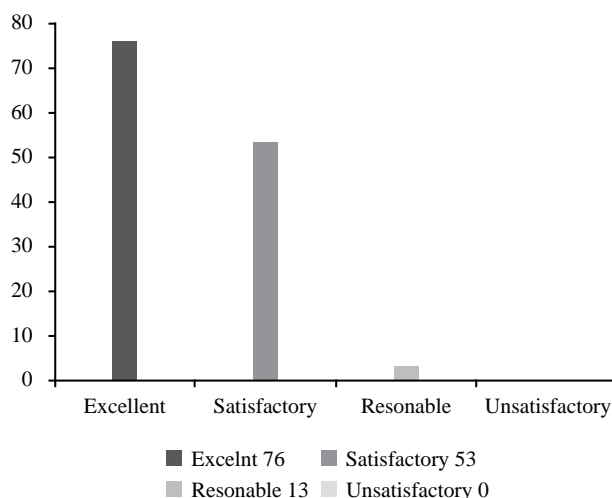
Figure 3 - Simulation home screen

ENFNET was subjected to evaluation after it was constructed. Students in undergraduate nursing courses in the School of Nursing at the University of São Paulo, specialists in IT and specialists in neonatology and/or neonatal intensive care were invited to evaluate the LMS.

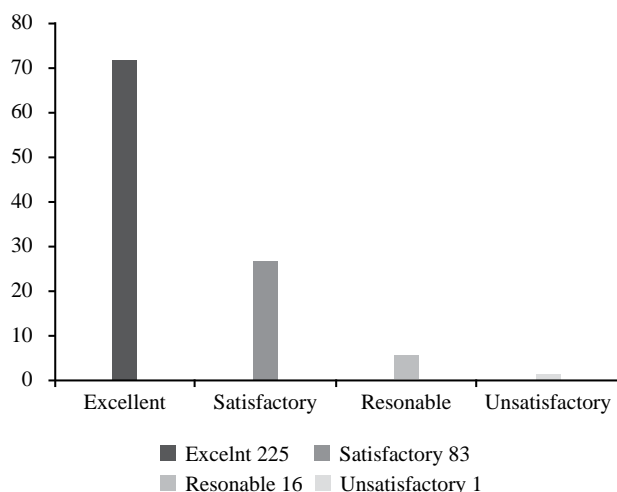
In evaluating the LMS, the thematic areas of evaluation for the specialists in IT were the *Response Time* (referring to navigability, accessibility, and system feedback to the user), *Interface Quality* (referring to the visual aspects of the LMS design, colors, menu, buttons and other iconographic elements) and *Tools and Resources* (referring to the form, presentation and operating system tools such as forum, email and portfolio).

The other specialists and students evaluated the following thematic areas: *Educational Aspects* (referring to the subject proposed for study, coherence of the elaborated educational objectives, texts and hypertexts used, activities and exercises, proposals for evaluating their learning, autonomy provided to the user and didactic resources used), *Environment Interface* (referring to navigability, accessibility and environment design) and *Didactic Resources* (referring to the interactivity of the system, functionality of the didactic resources and to the screen resources).

In the overall evaluation of the learning environment ENFNET, considering the 37 items evaluated by experts in IT and 43 evaluated by students and other experts, we obtained a total of 457 significant responses and six unanswered surveys. ENFNET was predominantly perceived as excellent, as shown in Figures 4 and 5. Few aspects were classified as reasonable, and only one aspect was rated as unsatisfactory.



**Figure 4** - Overall evaluation of ENFNET according to students - São Paulo, 2007



**Figure 5** - Overall evaluation of ENFNET according experts in IT, neonatology, education and distance learning - São Paulo, 2007

## DISCUSSION

The development and construction of a learning management system in all its aspects and complexities enabled greater knowledge and command of skills in IT, educational methodology and systems of teaching and learning.

Content creation and courseware design for a distance learning course and setting it in an LMS (known as MOODLE or TelEduc) have been performed countless times, and they were important exercises in instructional design. We decided to go beyond this stage and chose to construct a virtual environment that was free, easy-to-use, intuitive, enjoyable and that would meet the purpose of promoting continuing education for nursing.

The required study of computer programs, accessibility and operational issues, management of virtual environments, the building of exercises that provide feedback to the student and, above all, allowing communication among participants to promote the exchange of knowledge and the development of learning communities enabled us to truly experience the construction of an LMS.

ENFNET was developed exclusively for nursing and remains hosted on the server of the School of Nursing at the University of São Paulo. It is available for use by students, teachers and graduates who are interested in distance learning and have the desire and need to share knowledge.

The data obtained from the evaluations by students and experts in IT, education, neonatology and intensive care were extremely informative and fully validated the objective of this study. ENFNET proved to be an intuitive virtual environment that was visually pleasing and had good navigation and accessibility. It has tools that enable greater interaction between tutors and students, and it enables students to interact through the forum, email and the portfolio. The formation of discussion groups and the topics discussed in the forums make the group more cohesive and maintain the level of information and interest of the participants.

A good learning management system should be dynamic, allowing modification and adaptation of the material under study, as required by the tutor and the students<sup>(4)</sup>. ENFNET provides this functionality, and it allows the insertion of different types of exercises with feedback to the student and the recording of data in the administration area that are available to the tutor.

It has been observed that the efficiency of an LMS lies not only in its complexity and the quantity of tools but also in the quality of the developed teaching material and the experience of the tutor in the correct use of those tools to engage students while keeping them interested and motivated. To conceive, organize and modify educational material so that it is appropriate to the purpose and subject of study requires knowledge and dedication.

Nursing professionals do not have consistent experiences in the use of these technologies, so the appearance and presentation of the LMS and the use of a few specific tools in the virtual environment help to adjust the use of and interaction with an LMS for those individuals who have never had this experience<sup>(1)</sup>.

We consider the possibility of using simulation an essential resource for the teaching-learning process for nursing activities because it promotes the experience of situations that are common to professional practice and the exercise of decision making by the student<sup>(11)</sup>.

## CONCLUSION

The use of this methodology for creating the proposed virtual learning environment and contextualized

instructional design was decisive for the development and implementation of ENFNET, providing safe, objective and clear guidance for the realization of the project.

The application of virtual learning environments in a coherent, responsible and consistent way to support traditional teaching has been proven to be an efficient way to increase knowledge, foster student autonomy in the pursuit and comprehension of content, develop skills and improve students' discourse and their ability to argue and work together with other participants, and it represents an excellent opportunity for professional training.

Considering the current context of growth and specificity of distance learning online, there is a need to develop skills to handle new IT technologies to contribute to the development of methods, techniques and strategies for building LMSs directed toward distance learning in nursing.

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