

# Distance learning on surgical material sterilization processes

EDUCAÇÃO A DISTÂNCIA EM PROCESSOS DE ESTERILIZAÇÃO DE MATERIAIS

EDUCACIÓN A DISTANCIA EN PROCESOS DL ESTERILIZACIÓN DE MATERIALES

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## ABSTRACT

This study had the following goals: describing the development of a distance learning (DL) course on Surgical Material Sterilization Processes, to be given over the Internet; having the course evaluated by specialists in sterilization processes and in DL; describing students' and evaluators' profiles, and to evaluate the students' participation and their opinions about the course. The chosen course environment was TelEduc, and the teaching method was Case-Based Learning. The target population consisted of nurses from the greater Campinas area and other cities of the state of São Paulo. Fifty-eight nurses were invited, 14 were enrolled and 11 finished the course. The course was evaluated by specialists before and after its application. In order to evaluate the students' opinion of the course, a Likert questionnaire was used. The Case-Based Learning methodology helped student participation and the course was evaluated positively.

## KEY WORDS

Education, distance.  
Sterilization.  
Nursing informatics.

## RESUMO

Este artigo descreve as etapas de desenvolvimento de um curso de educação à distância (EAD) sobre Processos de Esterilização de Materiais, com o uso da Internet; sua avaliação por especialistas em processos de esterilização e em EAD; o perfil dos alunos e avaliadores; a participação dos alunos e sua opinião sobre o curso. O ambiente de aprendizagem escolhido foi o TelEduc. Utilizou-se a metodologia de ensino Aprendizagem Baseada em Casos (ABC). A população-alvo foi constituída por enfermeiros da Região Metropolitana de Campinas e cidades do Estado de São Paulo. Dos 58 enfermeiros convidados, 14 se inscreveram e 11 finalizaram o curso. O curso foi avaliado pelos juízes antes e após a sua aplicação. Um questionário do tipo Likert foi utilizado para avaliar a opinião dos alunos. A metodologia ABC favoreceu a participação dos alunos e o curso foi avaliado positivamente.

## DESCRITORES

Educação a distância.  
Esterilização.  
Informática em enfermagem.

## RESUMEN

Este artículo describe las etapas de desarrollo de un curso de educación a distancia (EAD) sobre Procesos de Esterilización de Materiales utilizando Internet, su evaluación por especialistas en procesos de esterilización y en EAD, el perfil de los alumnos y evaluadores, la participación de alumnos y su opinión sobre el curso. El ambiente de aprendizaje escogido fue TelEduc. Se utilizó la metodología de enseñanza Aprendizaje Basada en Casos (ABC). La población objetivo constituída por enfermeros de la Región Metropolitana de Campinas y ciudades de São Paulo. De los 58 enfermeros invita-dos, 14 se inscribieron y 11 finalizaron el curso. El curso fue evaluado por jueces antes y posterior a su aplicación. Un cuestionario tipo Likert fue utilizado para evaluar la opinión de los alumnos. La metodología ABC favorece la participación de los alumnos y el curso fue evaluado como positivo.

## DESCRIPTORES

Educación a distancia.  
Esterilización.  
Enfermería informática.

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## INTRODUCTION

The idea of planning a long-distance updating course in sterilization processes for nurses was developed according to the results of the implantation of the Materials and Sterilization Center of the Nursing Department of Hospital Virtual Brasileiro.

The Virtual Hospital was a proposal that appeared in the 1990s, of using a large area of the Internet network, with a multimedia databank<sup>(1)</sup>. Since the amount of doubts and the search for Sterilization Processes by nurses were frequent, the elaboration of a long-distance course about the topic was considered.

The Materials and Sterilization Center - *Centro de Material e Esterilização (CME)* – is a service responsible for processing materials to be used in surgeries and several procedures in the hospital. It is up to this service to assure the sterilization processes and, in order to meet this goal, it is necessary to be able to count on skilled and trained professionals to execute the activities responsibly.

As nursing activities in this sector, we can cite: selecting and purchasing instruments and equipment for surgeries, monitoring the sterilization processes, training the teams, solving emergency problems in a surgery room, among others<sup>(2)</sup>. We can infer that the presence of the nurse is indispensable at the Materials and Sterilization Center in hospital institutions, where the quality processes are established.

The difficulty and cost of traveling, since updating courses are frequently held in large urban areas, as well as the impossibility of the nurse to be absent during work hours, were the main motivations for the development of a distance course in Sterilization Processes.

There are several advantages of Distance Learning (DL), such as: the course can be updated frequently and the professional does not need to travel, although there may be a need for limits on the number of students per class or per tutor<sup>(2)</sup>.

DL experiences in the nursing area have shown that the Internet is a useful auxiliary tool that makes it possible to break time and space limits, since it allows the students to establish their own times and space according to their necessities, interests and availability<sup>(3)</sup>.

DL aims to take education and knowledge updates to places that are far away from the large urban areas, which makes access to education easy anywhere in the country and the world<sup>(4)</sup>. The use of computer technology resources has brought new ways of reading, writing, thinking and acting. When the students receive information through the computer, they interpret it, update themselves and change,

developing their process of knowledge construction and elaboration<sup>(5)</sup>.

In view of this situation, this study aimed to develop and evaluate a long-distance course about Basic Concepts in Material Sterilization Processes for nurses, through the Internet. The goals of the present study are: describe the stages of course development and the profile of students and evaluators; evaluate the content, through specialist nurses in the material sterilization area and professionals with experience in DL, as well as students' participation and their opinion about the course.

## METHOD

The course about Basic Concepts in Material Sterilization Processes was aimed at nurses and, in order to have a homogenous group, non-specialist nurses were selected, or those with less than 5-year experience in the CME, without graduate education in this area. The target population comprised nurses of the metropolitan region of Campinas and other cities of the state of São Paulo.

It was a methodological research, involving the development, execution and evaluation of a DL course. The participation of the nurses happened voluntarily, and the project was approved by the FCM-Unicamp Ethic Committee (file #653/2004).

The course was developed according to the following stages: choice of the DL environment; definition of the educational approach; definition of topics and course development; evaluation of the course by specialists and evaluation of the students' participation and their opinion about the

course.

### Choice of the DL environment

The virtual educational environments are different pieces of software that store, make available and manage WWW (World Wide Web-type) content<sup>(6)</sup>. Such environments aim at offering courses through the Internet, making it easier for the educator to elaborate the course and make it available through the Internet, and monitoring the student's progress.

The TelEduc environment was chosen as the support for the elaboration of this course, because it favors interaction and collaborative construction of knowledge<sup>(7)</sup>. TelEduc is a freely distributed software, jointly developed by researchers of Núcleo de Informática Aplicada à Educação-Nied (Education IT Center) and Instituto de Computação-IC (Computer Institute) at State University of Campinas-Unicamp<sup>(6)</sup>.

There are several advantages of Distance Learning (DL), such as: the course can be updated frequently and the professional does not need to travel, although there may be a need for limits on the number of students per class or per tutor.

Each course supported by the TelEduc environment can use a subgroup of tools. The management tools support the coordinator and the educators in the management of registrations and determination of start and end dates of the course. These are: View/Alter course data and program; Choose and Highlight course tools; Register Students and Educators; Management of Registrations, Students and Educators; Change Coordinator's Name and Send Password. The communication tools are used to promote interaction between students and educators, among students and among educators. They are represented by: E-mail, Chat, Discussion Groups, Bulletin Board, Portfolio, User's Log and Profile<sup>(8)</sup>.

The following tools were chosen to develop the *Material Sterilization Processes: Basic Concepts* course in the DL modality: Environment structure – information about the functioning of the long-distance course environment; Course Dynamics – method and organization of the course; Schedule – start page of the course with the topics of the day; Activities – tasks to be performed during the course; Support Material – useful information related to the course topics, supporting the development of the proposed activities; Discussion Forums – topics under discussion; Chat – real-time written communication, through the internet, between students and educators; E-mail: the environment's internal electronic mail system; Profile: A space reserved for each group member (student or educator) to introduce himself/herself informally, describing their main personal characteristics and with the option of adding a photograph; Portfolio – place where the students store all their production, i.e. texts and files used and/or developed during the course, as well as Internet page addresses found in their research. Intermap and Accesses: allow the educator to monitor the access frequency of the course users and the tools, as well as evaluating the interaction among the participants through charts or tables.

### Definition of the educational methodology

A constructivist educational approach was used for the elaboration of the course, because the long-distance course through the computer is strongly based on this approach, which encourages the student to research, induces towards group work and allows for the articulation of theory with practice, a very important aspect of permanent education<sup>(9)</sup>.

Within the constructivist educational approach, Case-Based Learning (CBL) was chosen as the teaching methodology, so as to provide students with the possibility of participating actively in the educational process, interacting with other participants of the course, so as to build knowledge with commitment, involvement and responsibility<sup>(10)</sup>.

According to the CBL methodology, *cases* are conceived as fictitious, contextualized situations, similar to real events, with the student being able to comprehend a situation through them, seeking information, concocting problems and proposing hypotheses to solve them, and also to reflect on the results<sup>(11)</sup>.

Two cases were elaborated for this course, introduced through the detailed description of the problem/situation. The cases were made available during the weekly modules. The students could look for information to solve these cases using the reference bibliography, which was available in the Support Material area, or by researching databases like LILACS and MEDLINE, access to specialists and question banks of Agência Nacional de Vigilância Sanitária (ANVISA). The students were also oriented to elaborate a case named *Real Case*, based on their own experience.

### Definition of the course topics

A research was performed before the course started, named *Distance Learning: themes of interest for nurses related to the intensive care unit and the materials and sterilization center*. Regarding the materials and sterilization center, the research identified the following themes as the most interesting and with the highest choice rates: cleaning of materials, heat-based sterilization processes and traceability.

The 58 nurses who participated in the research were contacted by e-mail or telephone and invited to fill out a check-list in order to verify if they met the profile required to participate in the course. As inclusion criteria, the nurses should meet the established profile, having internet access through an internet provider, having an e-mail account, having a basic understanding of computer operation and access to a computer for at least one hour a day. Registration for the course happened through a form sent by e-mail. Among the nurses who took part in the research, 14 enrolled in the course and 11 finished it.

### Course Development

In order to develop the course in the DL modality, the three most interesting themes were selected, since basic concepts in these topics are fundamental for the work of the professional responsible for the sterilization of materials. These themes were developed in two modules, lasting four weeks.

During the course, the students could develop the cases of Modules 1: Dirt in Materials and 2: Wet Material, with group discussion, using the Discussion Forums, Support Materials and Chats, with the constant encouragement of the course coordinator. Thus, the students could seek knowledge as active agents in the process.

Two in-person meetings were held: one at the start of the course, in order to discuss its dynamics and orient the usage of the TelEduc system, and one at the end of the course. The students were divided in groups in the first presential meeting to develop the activities of the course.

There were opportunities to clarify doubts online by e-mail. Also, the personal telephone number of the coordinator of the course was provided in case they needed to clarify doubts.

### Evaluation of the course by specialists

DL specialists and Material and Sterilization Processes specialists participated in the elaboration of the course. The DL specialists should belong to an educational institution, have a minimum three-year experience in the DL area, an e-mail and Internet access. The Material and Sterilization Processes specialists should have at least five years of professional experience and/or a Specialist title; be responsible for undergraduate teaching in Sterilization Processes or work at a CME; have an e-mail, experience with computer operation and Internet access. The shorter experience time required for the DL specialists was due to the fact that this teaching modality, using the Internet, is still recent in our country. For the Material and Sterilization Processes specialists, the five-year experience is the minimum prerequisite demanded by the Brazilian Society of Surgical Center, Materials Center and Anesthetic Recovery Society - *Sociedade Brasileira de Enfermeiros em Centro Cirúrgico, Centro de Materiais e Recuperação Anestésica (Sobecc)* – for the acquisition of the title of Specialist in Surgical Center, Materials Center and Anesthetic Recovery.

Thus, the course was submitted to three DL specialists in Material and Sterilization Processes and two DL specialists, who evaluated the first module of the course before it was offered, in order to verify if the proposal and the method chosen were adequate. The course was evaluated again after it had finished. The specialists were registered as visitors and sent individual passwords so that they could perform the evaluation.

An instrument, previously used and validated in another study<sup>(12)</sup>, was used to evaluate the following aspects: authorship, general information content, information presentation, information reliability and educational project. The final score allows for the classification of the course in the following ways: it is adequate; it is adequate, but needs slight reformulations; it is adequate, but needs reformulation; it is not adequate and needs to be reformulated.

Friedman's comparative test was used to compare the evaluations of the three judges who were specialists in sterilization. For the evaluations of the two DL specialists, Wilcoxon's test for paired samples was used<sup>(13)</sup>.

### Students' Evaluation

The students' evaluation permits measuring whether the course goals were met and whether the methodological strategies were adequate. The Brazilian DL legislation, as well as the legislation of several other countries, requires the student to be evaluated in-person<sup>(14)</sup>.

Since a greater emphasis was put on the evaluation of the process in the course proposal, this evaluation was done through participation in the activities developed during the

course: profile availability, participation in discussion forums and chat sessions, participation in the elaboration of group and individual cases. The goals of the in-person meeting at the end of the course were: presenting the student's Real Case and guaranteeing the execution of the final evaluation. The final grade was calculated as the average between the coordinator's evaluation (N1) and the student's self-evaluation (N2).

### Evaluation of the course by the students

The students could also express their opinion, filling out an instrument that was similar to the one developed for a long-distance course about wound healing<sup>(12)</sup>, where the evaluated items are presented on a Likert-style scale, with statements expressing positive or negative statements about the course. The respondents should indicate their choices by agreeing (or strongly agreeing), disagreeing (or strongly disagreeing) or maintaining neutrality towards each statement. Three open-ended questions were added to the instrument, which contemplated the opinion in view of the course tools, the educational material, the usage of audiovisual resources, the course efficiency, besides a space for suggestions. The internal consistency of the instrument was verified with Cronbach's Alpha coefficient, which is used to verify the homogeneity of the items in the instrument, i.e. its accuracy<sup>(15)</sup>.

## RESULTS

### Course development

Of the 58 nurses contacted at first, 14 (24.1%) enrolled in the course and, out of these, 11 (78.6) finished the program. According to literature, the sample size met the recommendation for a highly interactive long-distance course, i.e. one professor being responsible for 10 students<sup>(16)</sup>. In case of more students, it is recommended that a tutor be added.

The 11 nurses who finished the course were female, with an average age of 40.1 ( $\pm$  5.7) years, minimum age of 27 and maximum 47 years. As for the time since graduation, the average was 17.1 ( $\pm$  5.3) years, the shortest 5 and the longest 22 years. Regarding the type of institution they worked at, 7 (63.6%) worked in hospitals, one was a graduate student, one worked at the Regional Healthcare Superintendence and one worked in a Basic Healthcare unit. The Materials and Sterilization Center was the predominant workplace, with 63.6% of indications. One of the students worked in continuous education, one in epidemiologic surveillance and one in family healthcare. The length of the experience in their respective areas was 2.2 years, minimum 3 months and maximum 5 years.

After the course, it was observed that the most often used tools of the TelEduc environment chosen for this course were: E-mail, Chat, Discussion Forum and Group Portfolio.

The students' evaluation permits measuring whether the course goals were met and whether the methodological strategies were adequate.

The E-mail tool was used to exchange messages between the participants and the coordinator. Even after the course was finished, some students continued using the E-mail.

The Chat tool allowed for real-time conversations among the participants. There was a satisfactory participation in this tool, with the discussion of the selected themes, as well as the exchange of experiences and personal topics.

The discussion Forums aimed at promoting discussions among the participants and the educator, in order to motivate the interaction and further the discussion of the module in question. The members of each group exchanged experiences about the reality found at their workplaces, the theme of the case addressed in each module and how these cases could be solved. The coordinator followed the discussions and asked investigative questions to the students, as recommended by other authors<sup>(10)</sup>.

In the Portfolio, the participants were able to store texts and files used and/or developed during the course, as well as Internet addresses.

According to the constructivist learning theory, using the CBL methodology, the coordinator responded to the groups' questions, but avoided simply conveying information, so that the students could search the answers they needed in the Supporting Material, inserted in the Activities Tool and in the suggested websites.

#### **Evaluation of the course by specialists**

The course was evaluated by three sterilization process specialists and two DL specialists. Of the two DL judges that participated in the beginning stage of the evaluation, only one performed the final evaluation.

The three sterilization process specialist judges were female, with average age of 48 ( $\pm 6$ ) years and 15.3 ( $\pm 4.5$ ) years of experience in the area, varying from 11 to 20 years.

Of the two DL judges, one was female and the other was male, respectively 54 and 34 years old, and the DL experience time was seven years and three years.

The result of the prior course evaluation (Module 1) for the Material Sterilization judges was the following: the course was considered adequate, but needing small reformulations on all criteria analyzed, except for Authorship, which was considered adequate.

According to the evaluation performed after the end of the course, the Material Sterilization specialists considered the course adequate for the criteria Authorship, Presentation of Information and Educational Project, and adequate, but needing small reformulations for General Information Content and Information Reliability.

For the DL judges, the evaluation result was the following: the course was considered adequate for the criteria Authorship and Educational Project. For the criteria General Information Content, Presentation of Information and Information Reliability, the course was considered adequate, but needing small reformulations.

For the DL specialist, the result of the course evaluation was the following: the course was considered adequate for the criteria Authorship, General Information Content, Information Reliability and Educational Project. For the criterion Information Presentation, the course was considered adequate, but needing small reformulations.

The comparative test of the evaluations of the three sterilization material judges before the course (Friedman's test) showed that judge 2 presented a significant disagreement with judge 1 ( $p = 0.01$ ). After the course, the difference between the evaluations of judges 1 and 2 was still significant, but lower ( $p=0.028$ ).

Among the DL specialist judges, no significant disagreement was detected before the course, using Wilcoxon's test for paired samples. It was not possible to perform statistical tests at the end of the course because the only evaluator was judge 1.

#### **Student's evaluation:**

As described above, the evaluation of the students by the course coordinator (N1) was done through their participation in the activities developed. A score was attributed to each activity of the student's evaluation during the course, as shown in Table 1.

In Table 1, the self-evaluation values are similar to those attributed by the coordinator. Therefore, the coordinator monitored the students' involvement in the work groups and their contributions to the Group Portfolio and Discussion Forums. The coordinator also used the Attendance Report tool for this evaluation.

**Table 1** - Evaluation of the students by the coordinator of the course Material Sterilization Processes: Basic Concepts, and self-evaluation by the students – Campinas, 2006

Student	Profile	Discussion Forums	Chat	Cases	Term Paper	Evaluation (N1)	Self-Evaluation (N2)	Final grade
Valor máx.	(1.0)	(1.0)	(1.0)	(3.0)	(4.0)	(10.0)	(10.0)	(10.0)
Student 1	1.0	0.5	1.0	0.5	4.0	7.0	7.0	7.0
Student 2	1.0	1.0	1.0	3.0	4.0	10.0	10.0	10.0
Student 3	0.5	1.0	0.5	1.0	4.0	7.0	7.0	7.0
Student 4	1.0	1.0	1.0	0.5	4.0	7.5	7.8	7.65
Student 5	0.5	0.5	1.0	1.0	4.0	7.0	8.5	7.75
Student 6	1.0	1.0	1.0	3.0	4.0	10.0	9.0	9.5
Student 7	1.0	0.5	1.0	1.0	4.0	7.5	9.0	8.25
Student 8	1.0	1.0	1.0	3.0	4.0	10.0	9.0	9.5
Student 9	0.5	0.5	1.0	1.0	4.0	7.0	7.0	7.0
Student 10	0.5	1.0	1.0	3.0	4.0	9.5	10.0	9.75
Student 11	1.0	1.0	1.0	1.0	4.0	8.0	7.0	7.5

**Student's evaluation of the course.**

Forty-five different responses to the three open-ended questions of the instrument used were grouped by similarity and categorized, which supported the enhancement of the course.

All 11 students answered the questionnaire at the final in-person meeting. The students either agreed or strongly agreed with most of the positive statements, reflecting a favorable opinion about the course (Table 2).

**Table 2** – Type of answer of the student to the statements expressing positive opinions about the course Material Sterilization Processes: Basic Concepts – Campinas, 2006

Statement	Favorable		Answer Neutral		Unfavorable	
	N	%	N	%	N	%
The Internet-based course helped me to develop computer operation skills	10	90.9	0	0.0	1	9.1
The long-distance course motivated my learning.	11	100.0	0	0.0	0	0.0
Taking this long-distance course encouraged me to get to know other long-distance courses about subjects of interest to me.	10	90.9	0	0.0	1	9.1
I believe that the characteristics of the long-distance course (flexible hours, comfort, my own pace) facilitated my learning process.	10	90.9	1	9.1	0	0.0
The use of images was appropriate.	8	72.7	3	27.3	0	0.0
I could take the course at my own pace, at my convenience.	7	63.6	1	9.1	3	27.3
I could participate in the elaboration of the course proposals.	7	63.6	3	27.3	1	9.1

When students disagreed with the negative statements, they expressed positive opinions about the course (Table 3). One of the students did not express an opinion about

the statement *The course is not flexible, i.e. I had no options to adequate it to my needs*, not being computed in the result.

**Table 3** – Type of student answer to the statements expressing positive opinions about the course Material Sterilization Processes: Basic Concepts – Campinas, 2006

Statement	Favorable		Answer Neutral		Unfavorable	
	N	%	N	%	N	%
It was not enjoyable to take this long-distance course through the Internet	0	0.0	1	9.1	10	90.9
I would not refer other people to this course.	0	0.0	0	0.0	11	100.0
I did not have access to a computer every time I needed it.	4	36.4	0	0.0	7	63.6
I had difficulties to read the text on the computer screen.	1	9.1	0	0.0	10	90.9
The content of the course did not contribute significantly to my learning.	0	0.0	0	0.0	11	100.0
The teacher did not motivate my learning.	0	0.0	0	0.0	11	100.0
The course language is not easy to understand.	0	0.0	0	0.0	11	100.0
The course did not encourage/require me to take responsibility for my learning.	0	0.0	0	0.0	11	100.0
The discussion forums (between teacher and students) used in the course did not contribute to my knowledge about the topic.	0	0.0	0	0.0	11	100.0
The course dynamics and the way it was built did not contribute to my learning.	0	0.0	0	0.0	11	100.0
The course is not flexible, i.e. I had no options to adequate it to my needs. *	0	0.0	0	0.0	10	90.9

The obtained Cronbach's Alpha coefficients evidenced that the positive statements were less consistent than the negative ones. Therefore, the latter were more coherent (Cronbach's Alpha coefficients of 0.44 and 0.69, respectively). The general coefficient found was 0.77, which represents good consistency for the instrument (> 0.60).

## DISCUSSION

The success of a well-elaborated long distance course depends on several factors and a well-developed educational approach, which allows the student to seek knowledge instead of simply absorbing it from the teacher, is a determining factor to avoid high evasion rates.

The greater interaction between professor and students, named *being together virtually*<sup>(17)</sup> seems to have been reached in the present course, made evident by the low evasion rate (21.4%) when compared to other studies, which found rates of 39<sup>(12)</sup> to 90%<sup>(9)</sup>.

Regarding the profile of the students who finished the course, they were mature, experienced professionals from several professional contexts, sharing their interest in the theme and the fact of not being specialists in the area.

In the constructivist view, cooperative work is essential for the education of healthcare professionals and should be seen as the permanent possibility to exchange individual and collective experiences, where the establishment of

combinations and commitments is a fundamental condition for learning<sup>(18)</sup>.

The TelEduc environment, built specifically for distance learning, was found adequate for the development of the constructivist proposal adopted in the course, providing the students with better methods of organizing their work and allowing the coordinator to adapt the program to the students' needs. It is important to be able to implement a virtual environment that favors the students' active participation in their learning process and the exchange of ideas and experiences among students, making group discussion and cooperative work possible<sup>(11)</sup>. The TelEduc environment, by allowing discussion among students through the E-mail and Discussion Forum tools, favors the execution of this type of activity.

Among the TelEduc environment tools chosen for this course, the most used, as previously described, were E-mail, Chat, Discussion Forum and Group Portfolio, i.e. tools that favor interaction and allow for collaborative work, since they allow for the discussion of themes and the execution of group-based tasks. The adequate choice of the interaction tools is a primordial factor for the success of a long-distance course, and several cases of failure in courses like this stem from the inadequate use of these tools<sup>(9)</sup>.

As described before, the CBL teaching methodology was used as the strategy for the execution of course activities. The case-based discussion made the students think about important topics, which were gradually built collectively

about the content of the case. According to some authors, in the conceptual CBL model, the student is considered the center of the learning process and, as such, needs to interact with other students<sup>(11)</sup>. Therefore, a learning environment which provides this interaction, such as TelEduc, is extremely important for a long-distance course using this type of methodology.

By comparing the judges' evaluations before and after the course, it can be observed that the first evaluation allowed for the enhancement of the course. At the end, both the sterilization specialist judges and the DL specialist judges considered the course adequate for the criteria Authorship and Educational Project. For the other criteria, the course was considered to be adequate, but needing small reformulations.

The students' evaluation was performed procedurally, i.e. monitoring the students in their activities through the attendance report of the Access tool, in the elaboration and discussion of the cases and evaluation of the term papers, both qualitatively and quantitatively. Procedural or formative evaluation is considered the most adequate for long-distance courses, because it permits monitoring the students' activity during the learning process, considering the construction of each student's knowledge and allowing for the reorientation of the teaching and learning routes<sup>(19)</sup>. It is considered ideal for continuous evaluation, which makes it possible for the professor to manage and organize learning situations, changing the context if necessary. Procedural or formative evaluation is *centered on learning management*<sup>(20)</sup> and seeks to guide the students to facilitate their progress. Each activity done in the Internet-based courses and the whole group are evaluated, throughout the course, with a strict relation with the adopted strategies of collective knowledge construction<sup>(21)</sup>. Therefore, the quantitative-qualitative evaluations can and should be used for continuous procedural evaluation<sup>(21)</sup>.

As for the opinions of the students about the course, the results obtained indicate that the students had favorable opinions. However, computer access and the partici-

pation in the course according to the student's pace and the convenience were shown as problems. Although access to a computer was a prerequisite for enrolling in the course, the students may have had difficulties in balancing their schedule with the periods of availability to use the computer, whether at work or at home. Although the course is virtual and not time-dependent, the study hours are *real*. Thus, the students should be oriented to plan their study schedule, the access to a computer and other aspects that can jeopardize their participation and even erode their motivation, making them quit the course.

Still on the students' comments, they signaled that the educational methodology for the construction of the knowledge was appropriate and well-conducted. Some students also stated that the course considerably improved their theoretical/practical knowledge about the sterilization process and the daily activities at a materials sterilization center.

## CONCLUSIONS AND FINAL CONSIDERATIONS

The participation of the students was satisfactory, according to the evaluation of the course coordinator and the students themselves. With the analysis of the students' and judges' evaluations, it can be concluded that the course was successful due to the right choice of the educational proposal and the learning environment. In addition, the content of the course was adequate and relevant for professional practice.

The course in question can be considered as a first experience that, after reviewing and enhancing, could be replicated in order to reach a wider audience. Indeed, as a future perspective of this study, this course is intended to be published for governmental or municipal organs, as suggested by some of the evaluators.

It is believed that Internet-based DL can collaborate with permanent education, since, in a country with such great educational gaps, easy DL access can eliminate geographical barriers and gradually promote quality education.

## REFERENCES

1. Lopes MHBM. O projeto: o Departamento de Enfermagem do Hospital Virtual Brasileiro. *J Bras Enferm.* 1997;21(140):3.
2. Quelhas MCF. A educação a distância em processos de esterilização de materiais com o uso da Internet [dissertação]. Campinas: Universidade Estadual de Campinas; 2006.
3. Dias DC, Cassiani SHB. Educação de enfermagem sem distâncias: uma ruptura espaço/temporal. *Rev Esc Enferm USP.* 2004;38(4):467-74.
4. Fridman MW. O papel do ensino a distância através da Internet na educação médica continuada. *Rev Med PUCRS.* 1999;9(4):252-6.
5. Melo FNP, Damasceno MMC. A construção de um software educativo sobre ausculta dos sons respiratórios. *Rev Esc Enferm USP.* 2006;40(4):563-9.
6. Rocha HV. Projeto TelEduc: pesquisa e desenvolvimento de tecnologia para educação à distância [texto na Internet]. Campinas; 2002. [citado 2004 out. 29]. Disponível em: [http://www.teleduc.org.br/artigos/premio\\_abed2002.pdf](http://www.teleduc.org.br/artigos/premio_abed2002.pdf)
7. Franco MA, Cordeiro LM, Castilho RAF. O ambiente virtual de aprendizagem e sua incorporação na UNICAMP. *Educ Pesq.* 2003;29(2):341-53

8. Teleduc [homepage na Internet]. Campinas: UNICAMP; c1994-2008. [citado 2005 dez. 10]. Disponível em: [http://www.ead.unicamp.br/~teleduc/pagina\\_inicial/estrutura.php](http://www.ead.unicamp.br/~teleduc/pagina_inicial/estrutura.php)
9. Loyolla W, Prates M. Ferramental pedagógico da educação a distância mediada por computador (EDMC) [texto na Internet]. São Paulo: ABED; 2001. [citado 2004 abr. 25]. Disponível em: <http://www.abed.org.br/publique/cgi/cgilua.exe/sys/start.htm?UserActiveTemplate=4abed&infoid=158&sid=107>
10. Waterman MA. Caso investigativo como estratégia de estudo para a aprendizagem de biologia. In: Ensino de Biologia via Casos em Escolas Secundárias Brasileiras: metodologia dos casos [texto na Internet]. [citado 2005 jul. 16]. Disponível em: [http://cstl-csm.semo.edu/biocases/portuguese/portuguese\\_metodologia.htm](http://cstl-csm.semo.edu/biocases/portuguese/portuguese_metodologia.htm)
11. Reis EM, Rezende F, Barros SB. Formação continuada a distância de professores de física de nível médio: desenvolvimento e avaliação de um Curso Piloto com Suporte na Internet. [texto na Internet]. São Paulo: ABED. [citado 2008 jul. 17]. Disponível em: <http://www.abed.org.br/publique/cgi/cgilua.exe/sys/start.htm?UserActiveTemplate=4abed&infoid=157&sid=107>
12. Ribeiro MAS, Lopes MHBM. Desenvolvimento, aplicação e avaliação de um curso à distância sobre tratamento de feridas. *Rev Lat Am Enferm*. 2006;14(1):77-84.
13. Fleiss JL. *Statistical methods for rates and proportions*. 2<sup>nd</sup> ed. New York: John Wiley; 1981.
14. Brasil. Lei n. 9394, de 20 de dezembro de 1996. Estabelece as Diretrizes e Bases da Educação Nacional. Art. 80. O Poder Público incentivará o desenvolvimento de programas de ensino a distância, em todos os níveis e modalidades de ensino, e de educação continuada [legislação na Internet]. Brasília; 1996. [citado 2008 jul. 17]. Disponível em: [http://www.planalto.gov.br/ccivil\\_03/leis/L9394.htm](http://www.planalto.gov.br/ccivil_03/leis/L9394.htm)
15. Siegel S. *Estatística não-paramétrica para as ciências do comportamento*. São Paulo: McGraw-Hill; 1975.
16. Franco MA. Orientações para o desenvolvimento de cursos mediados por computador [texto na Internet]. Campinas: UNICAMP; 2003. [citado 2004 out. 27]. Disponível em: <HTTP://www.rau-tu.unicamp.br/nou-rau/ead/document/?view=24>
17. Valente AJ. Diferentes abordagens de educação à distância: NIED – UNICAMP e CED – PUC/SP [texto na Internet]. [citado 2004 ago. 21]. Disponível em: <http://www.proinfo.mec.gov.br/biblioteca/textos/txtaborda.pdf>
18. Carvalho MAP. Análise de um ambiente construtivista de aprendizagem a distância: estudo da interatividade, da cooperação e da autonomia no curso de gestão descentralizada de recursos humanos em saúde [dissertação]. Rio de Janeiro: Núcleo de Tecnologia Educacional para a Saúde, Universidade Federal do Rio de Janeiro; 2000.
19. Rezende RLSM. Avaliação processual e formativa na educação à distância [texto na Internet]. São Paulo: ABED; 2004. [citado 2005 nov. 20]. Disponível em: <http://www.abed.org.br/congresso2004/por/htm/091-TC-C3.htm>
20. Hadji C. *A avaliação: regras do jogo*. Porto: Porto Editora; 1994.
21. Gómez MV. Avaliação formativa e continuada da educação baseada na Internet [texto na Internet]. São Paulo: ABED; 1998. [citado 2005 dez. 11]. Disponível em: [http://www.abed.org.br/antiga/htdocs/paper\\_visem/margarita\\_vitoria\\_gomez.htm](http://www.abed.org.br/antiga/htdocs/paper_visem/margarita_vitoria_gomez.htm)