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Correia Ferreira Galvão, Elizabeth; Alves Araújo Püschel, Vilanice
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Multimedia application in mobile platform for teaching the measurement of central venous pressure*

APLICATIVO MULTIMÍDIA EM PLATAFORMA MÓVEL PARA O ENSINO DA MENSURAÇÃO DA PRESSÃO VENOSA CENTRAL

APLICACIÓN MULTIMEDIA EN LA PLATAFORMA MÓVIL PARA LA ENSEÑANZA DE LA MEDICIÓN DE LA PRESIÓN VENOSA CENTRAL

Elizabeth Correia Ferreira Galvão¹, Vilanice Alves Araújo Püschel²

ABSTRACT

This study aimed to develop and assess an application software for the teaching of the procedure *Manual Measurement of the Central Venous Pressure* which can be used in mobile devices. The research was conducted in three phases (Survey of needs; Methodology for multimedia application development and evaluation of the multimedia application). The multimedia was the method chosen because it favors an encouraging and dynamic environment, as it integrates images and texts into an application software available for cell phones, constituting a mobile and autonomous means for learning. The research allowed to demonstrate the feasibility of the development from this pedagogical tool and open up prospects for believing that, in Nursing education, the technology available can uncover new ways of learning in a meaningful manner.

DESCRIPTORS

Central venous pressure
Teaching
Learning
Technology
Nursing informatics

RESUMO

O objetivo do estudo foi desenvolver e avaliar um aplicativo multimídia em plataforma móvel para o ensino da Mensuração da Pressão Venosa Central (PVC). A pesquisa foi desenvolvida em três fases (Levantamento das necessidades; Metodologia de desenvolvimento do aplicativo multimídia e Avaliação do aplicativo multimídia). A multimídia foi o método escolhido por favorecer um ambiente motivador e dinâmico, integrar imagens e textos num aplicativo disponível para celulares, constituindo-se um meio móvel e autônomo de aprendizagem. Os resultados permitem demonstrar a viabilidade do desenvolvimento da ferramenta para subsidiar a prática pedagógica e abrem perspectivas para acreditar que, na educação em Enfermagem, a tecnologia disponível pode descortinar novos modos de aprender significativamente.

DESCRIPTORES

Pressão venosa central
Ensino
Aprendizagem
Tecnologia
Informática em enfermagem

RESUMEN

El objetivo del estudio fue desarrollar y evaluar una aplicación multimedia en la plataforma móvil para la enseñanza Medición de la Presión Venosa Central (PVC). La investigación se llevó a cabo en tres fases (estudio de las necesidades, metodología para el desarrollo de aplicaciones multimedia y evaluación de la aplicación multimedia). Multimedia fue el método elegido para proponer un ambiente dinámico y motivador, la integración de imágenes y texto en una aplicación disponible en los teléfonos móviles, convirtiéndose en un medio de aprendizaje móvil y autónomo. Los resultados nos permiten demostrar la viabilidad de desarrollar una herramienta para apoyar la práctica docente y abrir perspectivas para creer que la educación en Enfermería, la tecnología disponible puede descubrir nuevas formas de aprendizaje de manera significativa.

DESCRIPTORES

Presión venosa central
Enseñanza
Aprendizaje
Tecnología
Informática aplicada a la en enfermería

*Derived from the dissertation "Aplicativo multimídia em plataforma móvel para o ensino da mensuração da pressão venosa central", Post-graduate Program in Adult Health of the University of São Paulo School of Nursing, 2012. ¹Registered Nurse. Doctoral Student of the Post-graduate Program in Adult Health Nursing of the University of São Paulo School of Nursing. Professor of the Undergraduate Nursing Course of the Paulista University. São Paulo, SP, Brazil. ²Registered Nurse. Associate Professor of the Department of Medical-Surgical Nursing of the University of São Paulo School of Nursing. São Paulo, SP, Brazil. vilanice@usp.br

INTRODUCTION

The monitoring of vital functions is one of the most important tools in the management of critically ill patients in the Intensive Care Unit (ICU). Currently, it is possible to detect and analyze a range of physiological signals using different techniques including invasive and noninvasive procedures. The Central Venous Pressure (CVP) is the variable most used to estimate volemic status. Introduced in 1962, it constituted important developments for the analysis of volemia and cardiac function⁽¹⁾. The pressure within the right atrium or vena cava represents the most important of all venous pressures because it provides information on three parameters: blood volume, efficacy of the heart as a pump, and vascular tone⁽²⁻³⁾. The CVP measurement is a complex and detailed procedure, with various steps to be followed which, if not faithfully observed, can result in errors that compromise the values and interfere in the therapeutics conduct due to a false diagnosis.

The teaching procedure for measuring CVP, among others, is commonly accomplished through formal classes with description of the contents and practical classes in the laboratory⁽⁴⁾. Educational videos, with detailed description of the procedure are also used. However, the teaching must go hand in hand with computerization to enable extracurricular study and prepare students for the reality that they will find in field of practice, where knowledge and skills are needed to deal with situations similar to reality. The use of digital educational strategies has increased in Nursing education⁽⁵⁾.

It is necessary to search for innovative teaching that provides the closest possible experience to the actual situation and the visualization of practical handling, which can be obtained through digital technology. Among these technologies, the multimedia environments can be highlighted, which allow communication between the individual and the computer through the use of multiple means of information representation, such as text, images, sounds, animations and videos⁽⁶⁾. The development of multimedia environments has been shown to be valid as a training strategy, especially in the relationship between theory and practice, the focus of this study, and the relationships between knowledge and the contextualization of learning⁽⁷⁾. Given the above, the use of multimedia environments through applications, i.e., programs designed for these environments, is considered important, serving as a complementary tool to traditional Nursing teaching, aiming to promote education through new technologies.

into the interaction between the student and the digital equipment.

To enable the use of these applications the student's own cellular telephone can be used, which is a mobile technology accessible and present in all social classes, so that, at the time of the practical activity in the field, theoretical concepts can be accessed, problems solved and theoretical and practical associations made. Furthermore, the interactivity between the student and the mobile device can be facilitated by familiarity, in the case of mobile telephone use, with the technological accessory. The aim of this study was to develop and evaluate a mobile platform multimedia application for teaching the measurement of Central Venous Pressure.

METHOD

This is an applied study in the mode of technological production, consisting of three phases.

Phase I, called Needs Survey, corresponded to the first step in the development of the multimedia application characterized by the needs survey of undergraduate students in relation to the Nursing procedures that presented greater difficulty during the curricular internship.

Phase II is represented by the methodological development of the mobile platform multimedia application for the teaching of CVP measurement.

Phase III consisted of the evaluation, by experts in education and Nursing care, of the mobile platform multimedia application for the teaching of CVP measurement.

The study was conducted at a private university in the municipality of Santos, São Paulo.

In phase I the profile of the students was identified in relation to digital fluency, to technology accessibility and to the more difficult procedures they performed during the internship period. The population sample was random, intentional and non-probabilistic, and was composed of 18 students of the Undergraduate Nursing course of the university cited. The inclusion criterion was that the students had completed the Supervised Curricular Internship in the Intensive Care Unit (ICU). Students were contacted at the end of the Critical Patient Care Nursing discipline, informing them about the research aims, identifying the researcher and expressing availability to clarify any eventual doubts.

A data collection instrument was applied, created by the authors of the present study, consisting of three distinct parts: the first, with characterization data; the sec-

ond, with questions regarding which specialized nursing procedures were more commonly performed with critically ill patients and which procedures accounted for some degree of difficulty for their implementation during the internship period, and the third, with questions about their knowledge of computing and the technology available. Data were analyzed using absolute and relative frequencies.

In Phase II, the development methodology of the multimedia application, Contextualized Instructional Design (CID) was opted for, which involves a constructivist proposal and consists of intentional action of planning, developing and implementing specific didactic situations, incorporating mechanisms that favor the contextualization⁽⁸⁾. Based on the CID model, the mobile platform multimedia application for the teaching of CVP measurement was developed in five steps, outlined below. The analysis, from the perspective of the CID, is to understand the educational problem and to develop a related solution. This phase involved the needs survey, the characterization of the target public, the collection of bibliographic references, the definition of the educational aims, the definition of the contents, the analysis of the technological infrastructure and the creation of a diagram to guide the construction of the tool.

The *Design*, where the pedagogical concept that will promote learning is defined, involved the planning and the production of the educational content, definition of the topics the writing of the modules, selection of the forms of media and the design of the interface (layout). The use of images and text, structured in topics, and connected by hypertext (links) was opted for.

The *Development* included the selection of the tools of the multimedia application, the definition of the navigation structure and the planning of the configuration of environments.

The *Implementation* involved the configuration of the technological educational tools and resources, as well as the construction of an environment for downloading the application from the internet and its installation on the mobile device.

The *Evaluation* consisted of the assessment by experts of the content, didactic resources and environment interface.

In Phase III, the application was evaluated by experts in the field of education and Adult Healthcare, considering the educational aspects, didactic resources and environment interface. The sample population for evaluating the application was random, intentional and non-probabilistic and was composed of eight nursing teachers in the Adult Health field. The inclusion criteria were: to be a teacher with a link to a Higher Education Institution (HEI); to have at least two years experience in teaching and care in the Adult Health area, and to have graduated in the Adult Health area. The teachers were invited to participate in

the evaluation of the application through a letter of invitation, sent by e-mail, which explained the aims and purposes of the research. After agreeing to participate in the study, dates and times were scheduled for the demonstration and handling of the application on the mobile telephone, according to the availability of the participants. After the demonstration and handling, the data collection instruments were distributed and fill by the participants.

The structured data collection instrument was composed of two parts⁽⁹⁻¹⁰⁾. The first consisted of identification data and the second addressed three evaluation criteria related to the educational aspects, the didactic resources and the application interface, with response concepts corresponding to the letters E, S, R and U representing *Excellent*, *Satisfactory*, *Regular* and *Unsatisfactory*, respectively. For the items evaluated as regular or unsatisfactory an explanation was requested in order to adapt and improve the application. The data obtained in the evaluation by the experts were analyzed using absolute and relative frequencies. The ethical issues involved complied with Resolution 196/96 of the National Health Council (1996), and the project was approved by the Research Ethics Committee of the University (protocol No. 601/10) and by the University. The Terms of Free Prior Informed Consent were signed by the students and experts who agreed to participate.

RESULTS

Results of Phase I – Needs Survey

The target public was characterized mostly by female students (83.3% - n=15), with ages ranging between 20 and 30 years (61.1% - n=11), who studied in the morning (72.2% - n=13). The majority (77.8% - n=14) worked as Nursing technicians and only a minority (22.2% - n=4) performed this role in critical patient care units. All had completed the supervised curricular internship module. Among the procedures identified as the most difficult, the measurement of CVP, represented 19.6% (n=10) of the citations, gasometry 17.6% (n=9), and hemodialysis control 11.7% (n=6) of the citations, which reinforced the importance of developing an application directed toward the theme of CVP measurement.

Regarding digital fluency, almost all of the 18 respondents, 94.4% (n=17), accessed the internet daily, in their own residence, to receive and send emails, browse news and social network sites, perform research, listen to music and watch videos. All the students participating in the needs survey phase had cellular telephones and more than half, 61.1% (n=11), had fixed desktop computers or notebooks. With regard to cellular telephone use, all the respondents used them to make and receive calls, to send text messages and to take photographs. Only 27% (n=5) used the telephone to download music and video files and to send and receive e-mails.

Results of Phase II - Presentation of the multimedia application

Two main topics were created: Central Venous Pressure and Measurement of the CVP (Figure 1), which are subdivisions of the central theme. For the first topic, Central Venous Pressure, there were seven modules: Module 1 - Concepts of CVP; Module 2 - Understanding CVP; Module 3 - Measurement of CVP; Module 4 - Reference values; Module 5 - Indications for CVP monitoring; Module

6 - Contraindications for CVP monitoring; Module 7 - Complications (Figures 2 and 3).

For the second topic, Measurement of CVP, three modules were created where the user could select the option they wanted to see: the materials needed, the technique itself, or the most frequent errors in this procedure. The display of the *Materials needed*, for example, provides the written list of the materials used (Figure 4). Presented below are some screens of the mobile platform multimedia application for teaching the measurement of Central Venous Pressure.



Figure 1 - Illustrative image of the content selection screen

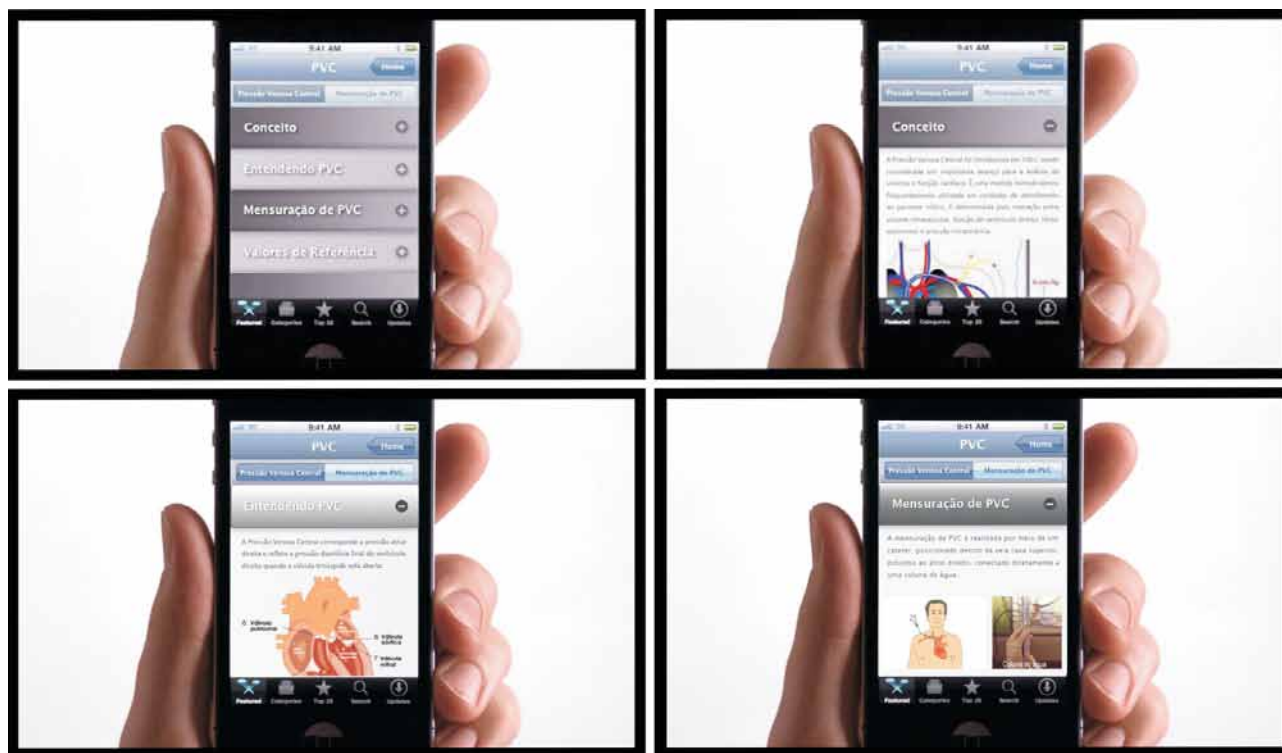


Figure 2 - Illustrative image of the Topic "Central Venous Pressure"

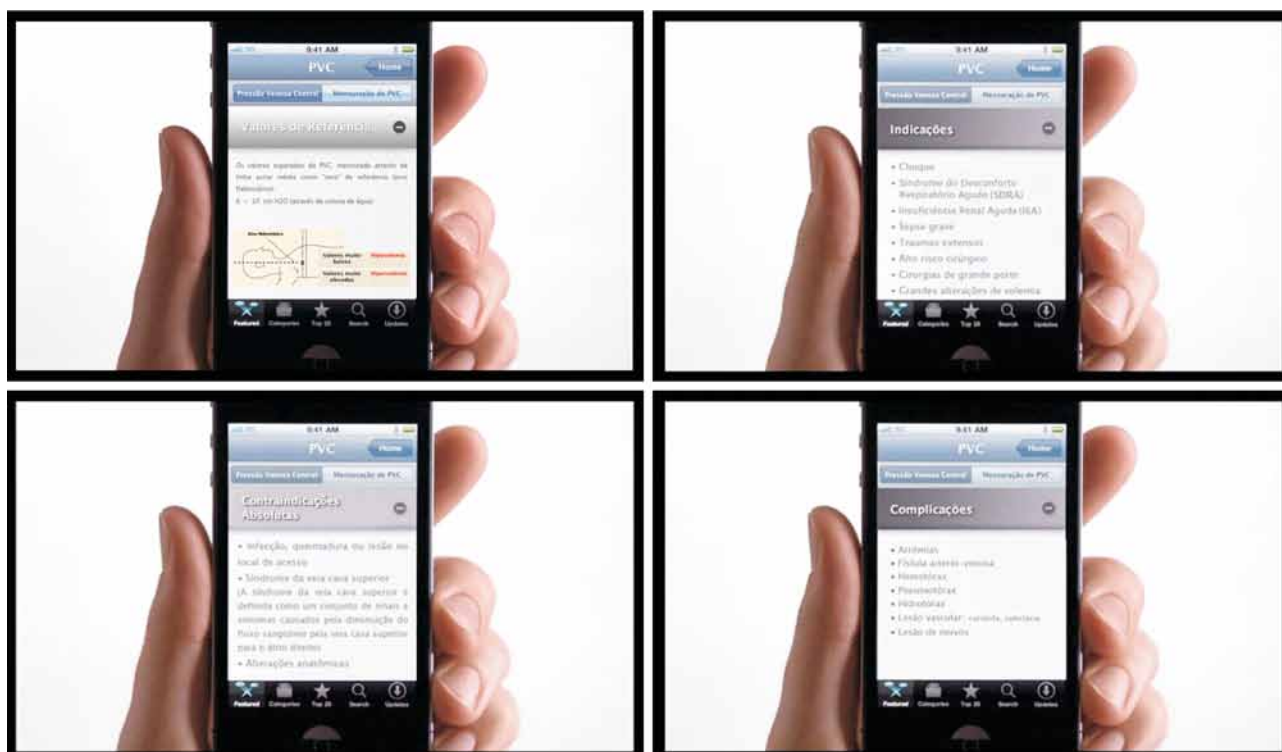


Figure 3 - Illustrative image of the Topic *Central Venous Pressure*



Figure 4 - Illustrative image of the topic "Measuring CVP"

Results of Phase III - Evaluation of the multimedia application

The experts who evaluated the multimedia application were characterized mostly by females (75% - n=6), with ages varying between 32 and 45 years (75% - n=6) and length of professional experience of between 15 and 25 years (62.5% - n=5). The teachers who held master's degrees represented 37.5% (n=3) and the specialists 62.5% (n=5). The majority of the evaluators were specialists in Adult Health Nursing (50% - n=4) and had more than five years of teaching. The evaluation results were analyzed according to the criteria established for the evaluation of the application (educational aspects, didactic resources and application interface), according to the concepts established as *Excellent*, *Satisfactory*, *Regular* and *Unsatisfactory*.

After analyzing the data, it was found that the items evaluated in the criterion *educational aspects* amounted to a total of 32 responses. The experts evaluated 30 items (93.7%) as *excellent* and, two items (6.3%) as *satisfactory*. It is noteworthy that the items of *Relevance of the Theme* and *Coherence of the Contents* were evaluated as *excellent* by all the experts. In the criterion *didactic resources* the total items answered by the experts was 24, with 15 items (62.5%) rated as *excellent*, six items (25%) as *satisfactory* and only three items (12.5%) as *regular*. The item related to the presentation of the figures was rated as *excellent* and *satisfactory* by the majority of the experts. However, there were two *regular* scores. The items classified as *regular* relate to a lack of audio and the size of some images.

Two experts presented suggestions. One of them mentioned the benefit that the dimensional increase of the images of the materials needed for the measurement of central venous pressure could bring for the students, since they have little contact with the materials. A better view of the images implies faster and easier recognition of the material. The other expert suggested adding audio tracks, with the respective subject of the module, or the preparation of video that combines image and sound, as complementary resources. The access to the internal link (hypertext) was classified as *excellent* by the majority of the experts.

Regarding the *environment interface*, 24 items were also answered. Of these, seventeen items were rated as *excellent* and seven as *satisfactory*, representing 70.8% and 29.2%, respectively. The *navigability* and *accessibility* were classified as *excellent* by the majority of the experts. The item *design* of the screens, of the interface criterion, is related to the organization of the content, size of letters and colors adopted. This item was classified as *excellent* by the majority of the experts.

DISCUSSION

The fact that the majority of the students were women confirms that the profession still remains female, as shown in the study⁽¹¹⁾ conducted in 2005, which indicates the feminization both in the university qualification, as well as at the technical level. It was observed that the majority of the students were young adults, corroborating the study⁽¹²⁾, which shows that the Nursing undergraduate degree course is composed, mostly by young adults. Another study⁽¹³⁾, also indicates that 60.4% of the students entering into 28 schools of Nursing in the state of São Paulo, were in the age group 17 to 20 years.

It appears that most of the students were already working as nursing technicians, which reveals their practical Nursing experience, although without the actual experience or theoretical foundation for performing complex procedures. The demand for the undergraduate course by these professionals has a direct relationship with the search for a better position in the labor market. This demand is justified by the author due to Nursing being (...) *a less selective course, which allows professional growth, the acquisition of scientific knowledge and, consequently, makes it possible to change status within the team*⁽¹⁴⁾. This is possible also because the majority of the private HEIs favor the access of students to higher education courses through scholarships and flexibility of shifts⁽¹⁵⁾.

Students, especially those who have no previous experience in caring for patients in critical situations, when they experience such situations in the practice field, present difficulties in performing specific and complex procedures learned in theoretical classes. The measurement of CVP, indicated as the most difficult, is a complex and detailed procedure. When considering that the target public of this study consisted of undergraduate students, comprised of young adults, the majority of whom are accustomed to the use of computing technologies, it was chosen to explore this scenario for the development of a tool to support the learning. A study with students from the USP School of Nursing showed that the majority were young adults, aged 21 to 30 years, who had used computers for over three years and knew how to *navigate* the Internet⁽¹⁶⁾.

The use of mobile devices in education, especially of cellular telephones, can be justified by the large number of users and can constitute a resource for digital inclusion. As it is not possible to use computers or even laptops, in the patient care environment, it was chosen to develop a multimedia application for mobile devices, initially cellular telephones. Researchers affirm that

(...) the scope of the use of mobile telephones is a recent phenomenon reaching the contemporary in order to characterize this device as probably the fastest technology that has been horizontally adopted by the public in recent times⁽¹⁷⁾.

The focus of the use of this technology in education is centered on the possibility of the impact of its use in the teaching and learning process, i.e., in the incorporation of this technology as a resource for teaching and learning⁽¹⁸⁾. Resources that incorporate these technologies can offer the students control of their own learning, putting into practice the constructivist assumptions. Constructivism has been the approach used to guide the development of computerized educational materials⁽¹⁹⁾, because, in this pedagogical current, the individual is an active agent of their own knowledge⁽²⁰⁾ and interacts in a cognitive and behavioral way with the artifact of mediation which is the technology⁽²¹⁾. In the Horizon 2010 report, responsible for identifying the impact of technology in education, the potential was registered of mobile computing, using cellular telephones and tablets as tools in higher education institutions⁽²²⁾.

The topic approached is important for the practical practice of the student because it contains information needed to care for critical patients and represents a complementary contextual reinforcement to clarify any doubts. It can be observed, from the results of evaluation of the experts, that the application offers sufficient content, clarity in the concepts and consistency in relation to the theme.

In the selection and preparation of the content there was concern about providing the concepts clearly, using simple vocabulary and sufficient information, through short texts to avoid ambiguity and allow the transmission and reception of the messages. The texts must permit easy reading and quickly promote and obtain the expected learning results. The choice and presentation of the content should take into consideration their ability to activate the prior knowledge of the students⁽²³⁾.

The images should be viewed as the key-tool in the development of the pedagogical work, being attractive, as well as favoring a change of the routine in the conduction of the content and allowing different forms of apprehension of the content⁽²⁴⁾. The image, as well as fostering motivation, promotes intuitive knowledge and enables the comprehension of concepts that, if they were supplied only via text, would be more difficult to acquire⁽¹²⁾.

The advantages of an application that has the association of hypertext and images are that it quickly promotes the learning process, offers environments for the student to explore, and facilitates the recovery of relevant information by acting as a reminder. Moreover, it favors the construction of knowledge, allowing the students to define their own paths, which represents a huge potential for education. With regard to the *navigability*, it is believed to be adequate when it allows free access to the contents, stimulating learning. Therefore, the modules of the topic *Central Venous Pressure* and those of the topic *Measuring CVP* were constructed so as to allow free navigation of one module or the other, according to the pace of learning of each student. The easy access to the appli-

cation is through an icon, the same as the other applications on a cellular telephone.

The application was designed considering the importance that the colors, size and font of the letters have in the construction of applications, as a mechanism to facilitate the comprehension and appreciation of the contents. Therefore, bright colors and simple backgrounds were used. The use of simple backgrounds with neutral colors is recommended because it increases the visibility of the other colors used in the text⁽²⁵⁾. The color is a relevant resource and can make a difference in a text depending on the position and the contrast⁽²⁶⁾. It can be verified that the evaluation of the experts was crucially important for the adequacy and improvement of the application. The suggestions will be implemented in the continuation of this research.

Considering the enrichment of the teaching-learning process and the need to accompany technological developments, the importance is emphasized of developing tools that seek significant transformation in education and that represent other means of achieving educational aims and improving the quality of the teaching.

CONCLUSION

The constructivist theory, which basically considers learning a construction of the subject and has been the approach used to guide the development of computerized educational resources. This theory, combined with the integration of various forms of media, was used in the construction of this multimedia application, which can offer the student the opportunity to improve the relationship between theory and practice, to establish a correlation between learning and real experimental situations making learning more meaningful, more enriching. Considering the difficulties of the students in performing the Measurement of CVP procedure, which despite being routine is also complex, the use of dynamic and interactive digital resources presents itself as an alternative to enhance the learning process. Therefore, this application sought to address various aspects related to the measurement of CVP, from the selection of the most appropriate means for determining the learning process, considering the pedagogical aims, the characteristics of the users and accessibility to the medium, to the elaboration of a pedagogical language adequate for these components, in order to equip the student for when it is necessary to perform this procedure.

The digital learning environment, when aggregating multiple forms of media and available on mobile technology, in this case cellular telephones, becomes a privileged space, since it favors mobility and gives the student access in any place. In favor of this perspective is the significant use of mobile devices in our society, as well as the familiarity of their use for various activities, not only

as communication devices. The association of multiple forms of media offers an original and organized way to promote learning and, is considered an important tool, as it provides ample possibilities for perceptive exploration. Furthermore, grouping the visual and auditory potential enables interactivity according to the individual characteristics of the students, naturally generating motivation.

The pedagogical practice requires reflection and a search for alternative ways to instigate and to increase student interest for the construction and development of the synthesis of knowledge. The careful selection of educational software can foster greater proximity with the learning needs of Nursing students in the experiences in the field of practice. The use of information and communication technology as a support tool for the teaching of Nursing is increasing, as the benefits that it brings are evident. The integration of computers and other technological tools must be comprehended as an innovation

process and, as such, must meet the need for change and improvement that education pursues.

Considering the proposed aims, the results of this study permitted the planning, development and evaluation stages of the multimedia application *Central Venous Pressure* for use on mobile devices to be described. The steps followed open perspectives to believe that in the teaching of Nursing the available technology can uncover new forms of effective learning. It is considered that this study is an impulse for new investments in both the formation of the nurse, and in study groups of innovative technologies, so that other professionals can develop tools that assist the teaching-learning process, and open up a range of opportunities for the application of these technologies in other educational processes. To evaluate the efficacy of the application as a pedagogic instrument and its applicability in the quotidian of the students of undergraduate Nursing courses are considered key points for the continuity of this research.

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