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VALIDATION OF EDUCATIONAL HYPERMEDIA ABOUT PERIPHERAL VENIPUNCTURE

Natasha Marques Frota[1], Lívia Moreira Barros[2], Thiago Moura de Araújo[3], Marcos Venícios de Oliveira Lopes[4], Paulo César de Almeida[5], Joselany Áfio Caetano[6]

[1] Doctoral student in the Nursing Graduate Program of the *Universidade Federal do Ceará* (UFC). Fortaleza, Ceará, Brazil. E-mail: natashafrota_@hot.com
[2] Doctoral student in the Nursing Graduate Program of the UFC. Fortaleza, Ceará, Brazil. E-mail: livinha_mh@hotmail.com
[3] Ph.D. in Nursing. Fortaleza, Ceará, Brazil. E-mail: thiagomoura@yahoo.com.br
[4] Ph.D. in Nursing. Associate Professor from the Department of Nursing of the UFC. Fortaleza, Ceará, Brazil. E-mail: marcusv@ufc.br
[5] Statistician. Adjunct Professor at the *Universidade Estadual do Ceará*. Fortaleza, Ceará, Brazil. E-mail: ameilda@ufc.br
[6] Ph.D. in Nursing. Adjunct Professor at the UFC. Fortaleza, Ceará, Brazil. E-mail: joselanycaetano@ufc.br

ABSTRACT: The objective was to validate an educational hypermedia about peripheral venipuncture. This is a methodological study, conducted from January to October 2012, among nursing specialists and students. Binomial and paired t-tests were used for the analysis, where values of $p<0.05$ were considered statistically significant. The hypermedia content was considered effective by the specialists, because the values of the proportion among the specialists were greater than 85%. The hypermedia was classified as "very good" and "good" by 92.3% and 7.7% of students, respectively. It was deemed to be a resource that facilitates and complements the teaching-learning process. The hypermedia will assist the practice of nursing in the area of peripheral venipuncture, providing opportunities for future nurses to be qualified and able to promote health among the patients in their care.

KEYWORDS: Nursing. Education. Educational technology. Peripheral catheterization.

VALIDAÇÃO DE HIPERMÍDIA EDUCATIVA SOBRE PUNÇÃO VENOSA PERIFÉRICA

RESUMO: Objetivou-se validar uma hipermídia educativa sobre punção venosa periférica. Estudo metodológico, realizado de janeiro a outubro de 2012, com especialistas e estudantes de enfermagem. Utilizaram-se para análise os testes binomial e T pareado, em que foram considerados como estatisticamente significantes os valores de $p<0,05$. O conteúdo da hipermídia apresentou avaliação eficaz pelos especialistas, uma vez que os valores da proporção entre os especialistas foram maiores que 85%. A hipermídia foi avaliada como "muito boa" e "boa", por 92,3% e 7,7% dos estudantes, respectivamente. A hipermídia foi considerada como recurso facilitador e complementar no processo de ensino-aprendizagem. A hipermídia irá auxiliar a prática de enfermagem na área de punção venosa periférica, propiciando oportunidades para que futuros enfermeiros estejam aptos e sejam capazes de atuar com vistas à promoção da saúde à clientela por eles assistida.

DESCRITORES: Enfermagem. Educação. Tecnologia educativa. Cateterismo periférico.

VALIDACIÓN DE UNA HIPERMEDIA EDUCACIÓN SOBRE PUNCIÓN VENOSA PERIFÉRICA

RESUMEN: Validar una hipermedia educativo sobre venopunción. Se trata de un estudio metodológico, realizado en el período de enero a octubre de 2012 con especialistas y estudiantes de enfermería. Los contenidos de hipermedia tenían una evaluación efectiva por los especialistas como la relación entre los valores de los expertos fueron mayores que 85%. Hipermedia se evaluó como "muy buena" y "buena" por el 92,3% y el 7,7% de los alumnos, respectivamente. Esta opinión fue justificado por los estudiantes debido a hipermedia como facilitador de recursos y complementar el proceso de enseñanza y aprendizaje. Hipermedia pueda contribuir a la práctica de enfermería en el área de PVP, proporcionando oportunidades para las futuras enfermeras están en forma y capaz de actuar con el fin de promover la salud de los clientes atendidos por él.

DESCRIPTORS: Enfermería. Educación. Tecnología educacional. Cateterismo periférico.

INTRODUCTION

Peripheral venipuncture (PVP) is one of the most frequently performed nursing procedures in hospitals, because 80% of patients admitted to hospitals will use a venous catheter at some point. However, despite its common use and importance, intravenous treatment has risks, which can be minimized through appropriate intervention on the part of the nursing staff.[1]

The training of students and professionals is extremely important for reducing risks during the administration of drugs by the parenteral route,[2] and in promoting the safety of patients in clinical practice, which can be obtained through educational technologies.[3]

In this context, it was found that the use of information and communication technology (ICT) that seeks to foster distance education, making it collaborative and flexible for training nursing students in a relevant area of health, namely PVP, is important.[4] In order to use ICT, it is necessary to have a virtual learning environment (VLE) that can receive this technology. VLE corresponds to a technological environment in virtual space that enables the development of the teaching-learning process, mediated by ICT available on the Internet.[5]

Therefore, to be able to use this type of distance education through ICT, various media need to be combined in a computer support environment that includes hypertexts, videos, two-dimensional and three-dimensional interactive animations, audio, and images that can be mediated through hypermedia. Studies attest to positive nursing experiences through the use of ICT, such as digital educational objects in nursing[6] or educational hypermedia in sexual health—an approach to gynecological nursing care and educational hypermedia for teaching the measurement procedure for arterial pressure.[7]

For hypermedia to be applicable, it needs to undergo a validation process by specialists. Validation is a methodological approach that can be used to verify the content and construct of a technology. The concept of validity is understood as the degree to which an instrument is shown to be appropriate to measure whatever it is supposed to measure. Therefore, when an instrument is subjected to a validation procedure, it is not actually the instrument itself that is being validated, but the purpose for which the instrument will be used.[8]

There are different shortcomings in the teaching of nursing with respect to peripheral venipuncture, such as unavailability of appealing teaching resources and materials, the need for additional support for theoretical and laboratory classes, and not many opportunities to practice the procedure. There has also been a significant increase in the use of computers in nursing education, which increases the interest of students in learning and further enhancing their skills through the use of interactive teaching materials that provide greater safety and motivation in carrying out procedures. Consequently, this is a relevant study because its objective is to validate educational hypermedia about peripheral venipuncture.

METHOD

Methodological applied research related to technological production was conducted from January to October 2012, in three stages: construction of the hypermedia; validation by specialists; and evaluation by nursing students.

In the first stage of the study, which entailed constructing the hypermedia, a review was performed of articles, dissertations, theses, and books that addressed nursing procedures, evidence-based practices, and data from the Infusion Nursing Society (INS). Each piece of material was read and analyzed separately for adaptation to this study, and the content was into modules, through media involving animation, hypertexts, exercises, figures, and photos.

After the first version of the hypermedia was completed, the study moved into the second stage, at which time it was submitted for analysis by specialists in the area of nursing (content) and information technology (technical). In statistics, the number of people needed to comprise a sample is based, among other things, on the confidence level used and sampling error.[7]

To calculate the number of specialists who would be included in the study, it was decided to estimate the sample size based on the infinite population formula, with the statistical criteria in a minimum proportion of 85% agreement with the relevance of each item evaluated. A 15% difference was accepted in this agreement. The final calculation was determined by $n=1.96^2 \times 0.85 \times 0.15/0.15^2$ which yielded a sample of 22 specialists.[8] However, this study encompassed two areas of operation, so we chose 22 specialists in the area of nursing and 22 in information technology, for a total of 44 specialists.

The criteria adopted for inclusion of the nursing specialists were: having articles published in indexed journals in the area of interest, and at least five years experience in providing care. For the information technology specialists, the criteria were: training as a web designer or webmaster, and experience in VLE development. The search for specialists was done through the Lattes platform, where it is possible to access the production profiles of researchers and their areas of knowledge, in order to facilitate the analysis of the inclusion criteria for participation in the study and to ensure reliable evaluations.

The aspects assessed by the content specialists were objectives, content, relevance, and environment. The technical specialists evaluated functionality, usability, and efficiency. The response options were of the Likert type, comprised of the categories: strongly agree (SA); agree (A); disagree (D); totally disagree (TD); and not applicable (NA). At the end of the validation, the professionals were asked to give their opinion on the hypermedia, and the recommendations were reviewed and accepted. The new version of the hypermedia was then subjected to another process of editing, proofreading, and layout.

In the third stage of the research, students from the course entitled Nursing in the Adult Care Process II of the School of Nursing, Federal University of Ceará (UFC) were invited to participate in the study. This target population was chosen based on the inclusion criteria for students. The invitation was extended by the researcher during the activities of that course, at which time the environment was presented to the students through a computer connected to the Internet, along with the multimedia project. At that time, the students received information about the VLE, as well as the access address to the environment, login, and password.

The evaluation of the students was divided into three phases: a pretest, which assessed their knowledge prior to use of the hypermedia; completion of the course through the hypermedia; and a post-test, which assessed the students' knowledge about PVP after use of the hypermedia. Of the 28 students from the course who participated, 25 completed the pretest and 21 finished the course within the stipulated time and showed up on the scheduled date to do the post-test. Therefore, the final sample consisted of 21 students.

The selection criteria used for inclusion of students were to: be enrolled in the course; have some basic computer skills, such as how to turn a computer on and off, surf the Internet, use printing tools, and edit texts, as well as have time to use the virtual environment and commit to finishing the course within two weeks; and participate in the evaluation of the hypermedia.

For data collection, an instrument with 10 multiple-choice questions was used, with four answer options: a, b, c, and d. This instrument was based on criteria of the Infusion Nursing Society (INS) and has been used in similar evaluation research on the subject of PVP. The questions contained in the instrument were classified as scores according to the Item Response Theory (IRT), which helps interpret the difficulty level of each question. The scores were 1, 1.5, and 2, based on the degree of difficulty of each question. In the questionnaire, questions 1, 7, 8, and 9 were awarded a score of 1 point; questions 3, 4, and 6 received a score of 1.5 points; and questions 2, 5, and 10, a score of 2 points.

The data were compiled and analyzed using the Statistical Package for Social Sciences (SPSS), version 19.0, and later presented in tables. The statistical measures were calculated (mean and standard deviation) and an analysis of proportion was performed using the binomial test and paired t-test, in which values of $p<0.05$ were considered statistically significant.

The study was conducted in accordance with Resolution 466/12 of the National Research Ethics Commission (CONEP), which governs research involving human subjects. It was also submitted to the Research Ethics Committee of the *Universidade Federal do Ceará*, under Approval Protocol n. 215/11.

RESULTS

The mean age of the nursing specialists was 38.3 years (SD=8.6) and the length of time since graduation was 17.7 years (SD=9.89). The minimum age was 26 years and the maximum was 57. The minimum length of time since graduation among the specialists was two years and the maximum was 32. In this study, there was a slight predominance of nurses with PhDs compared to those with a master's degree.

With respect to the information technology specialists, the education of these professionals ranged from undergraduate to master's degrees, with a predominance of specialist degrees (68.2%). The area of expertise of the specialists was infor-

mation technology (86.4%), although 90.9% had experience in building websites and 68.2% had experience in activities involving distance education. The mean age of the specialists was 29 years (SD=7.23) and the mean length of time since graduation was 5.7 years (SD=7.81).

The gender of the 21 students who participated in the hypermedia evaluation process was predominantly female (95.2%). The mean age of the students was up to 25 years, with 33.3% up to age 20 and 66.7% between ages 21 and 25 years with a standard deviation of 1.384.

Regarding the students' experience in distance education, it was found that 52.4% had not previously taken such courses, and 47.6% of the participants had no experience in PVP, indicating that this was their first experience with this method of learning. Among the students who reported having experience with distance education, the themes they mentioned included family planning, pressure ulcers, chemotherapy, management in the Unified Health System, and ethics.

Internet access was one of the criteria for participation in the study and in order to carry out the educational intervention. Most of the students (95.2%) reported having easy Internet access at home and on campus, and those without easy access were restricted to Internet use at the university.

The hypermedia had six modules containing classes related to PVP, exercises, additional reading, and four illustrative videos. As far as the validation by the nursing specialists, they evaluated the items found in table 1 and provided feedback.

Table 1 - Evaluation of the hypermedia by nursing specialists in terms of objectives, content, relevance and environment. Fortaleza, Ceará, Brazil, 2015 (n=22)

Variables	n	p-value*
Objectives		
Consistent with the practice of nursing	22	1
Consistent with the content presented	22	1
Adequate to be put into effect	22	1
Content		
Accurately addresses the theme	22	1
Appropriate for nursing students	21	0.972
Sufficient number of classes and topics	21	0.972
Relevance		
The items illustrate important aspects for the practice of nursing	22	1
The items are relevant for the learning process of students	22	1
Consistent with the practice of nursing in this theme	22	1
Environment		
VLE is adequate for presenting the content	22	1
The resources are adequate for learning in regard to the theme	22	1
The resources provide learning situations	21	0.972

*Binomial test.

Regarding the consistency of the educational objectives with the nursing profession, the values of the items were significant, because the proportion among the specialists was above 85% (p=1), which validates this item.

The evaluation of the hypermedia content was also considered to be effective, because the values of the proportion among the specialists were higher than 85% (p=0.972). However, the specialists made suggestions to improve the presentation of the proposed content. One of the specialists thought the video on noncompliance actions was confusing, because it only showed what was done wrong during the procedure, which could mislead students as they watch the video. The same person suggested including the wrong procedure, but immediately followed by the right procedure. The suggestion was accepted and the video was corrected and loaded again into the hypermedia.

Another specialist suggested including additional materials in Portuguese, because not all students understand foreign languages. In addition to the content in English, supplementary texts in Portuguese were also added. In terms of the classes, two specialists suggested that Class 5 on "special patients" be divided into two topics - one on venipuncture in newborns and one on venipuncture in the elderly. The suggestion was accepted and implemented.

Another recommendation was to remove the photo of the tape, because one of the specialists claimed it was not advisable to use this adhesive tape. This point, however, was not accepted, based on the fact that although there are other adhesive tapes in the market, it is important that students can see what exists and what is available in health institutions.

Regarding the relevance of the items presented in the educational hypermedia, the specialists rated them as very good, because the proportions between them were greater than 85% (p=1), thus validating this item. In addition to the choice of theme being considered an excellent item with important aspects for the learning process, especially in the practice of nursing, the exercises were also viewed positively by the specialists. With respect to the environment, the items were considered valid, because the proportion was higher than 85% (p=1), although two specialists made some observations, and the questions were reviewed and modified as requested.

In the validation by the IT experts, they evaluated the items found in table 2 and provided suggestions.

Table 2 - Evaluation of the hypermedia by information technology specialists in terms of functionality, usability and efficiency. Fortaleza, Ceará, Brazil, 2015 (n=22)

Variables	n	p-value*
Functionality		
Is an adequate tool for the purpose for which it is intended	19	0.661
Enables good results to be generated	22	1
Usability		
Simple to use	21	0.972
Easy to learn the concepts used and their applications	21	0.972
Provides help in a clear way	22	1
Provides complete assistance	22	1
Provides quick, non-tedious support	22	1
Efficiency		
Number of classes is consistent with the proposed time frame	22	1
The resources are adequately used	22	1
The resources are used in an understandable way	22	1

*Binomial test.

Regarding the functionality of the hypermedia, it was deemed to be an adequate tool for its intended purpose, with a proportion of 86% (p=0.661), thus validating the section. Also in relation to functionality, the hypermedia enabled good results to be generated, with a proportion above 85% (p=1), which also made this item appropriate.

As far as usability, the hypermedia was considered easy to use and for learning the concepts used, providing clear, concise, and quick help, with a proportion above 85% (p=0.972). However, it was suggested to improve the mobility of the windows used to facilitate side scrolling and closing links, in addition to standardizing the color of the fonts used in the graphics and the references box. The suggestion was accepted. As far as usability, one specialist noted that the hypertexts of the classes from Modules 4 and 6 were not available, that is, there was no content. This problem was due to the inadequacy of the browser used, and it was necessary to adapt these hypertexts to all browsers.

The proportion for efficiency was also significant, above 85% (p=1), in terms of number of

classes and time, the way the resources are used, and an understanding of the resources in the hypermedia.

The main findings of the students are listed in table 3, which shows the results of the pre- and post-tests.

Table 3 - Distribution of the results of the questions related to the peripheral venipuncture knowledge of nursing students before and after the educational intervention. Fortaleza, Ceará, Brazil, 2015 (n=21)

Variables	Pretest*			Post-Test*		
	Correct		p-value†	Correct		p-value†
	f	%		f	%	
Questions worth 1 point						
1	13	44.8	<0.000	21	100	1
7	15	60	0.002	19	90.5	0.845
8	18	72	0.069	21	100	1
9	18	72	0.0690	18	85.7	0.629
Questions worth 1.5 points						
3	15	60	0.002	17	81	0.388
4	19	76	0.161	20	95.2	0.967
6	19	76	0.161	19	90.5	0.845
Questions worth 2 points						
2	11	44	<0.000	19	90.5	0.845
5	6	24	<0.000	18	85.7	0.629
10	16	64	0.007	18	85.7	0.629

* Frequency and percentage of correct answers of all the students, evaluated before and after the intervention; †Binomial test.

In the evaluation, 10 objective questions were used that were given scores according to the difficulty level. The mean for correct answers on the pretest was 8.2, with SD=2.4679, and the mean for the post-test was 11.9, with SD=1.8927.

In terms of content, Question 1 dealt with personal protective equipment (PPE); Question 2, anatomy of the venous network; Questions 3, 4, 5, and 6, local and systemic PVP complications; Question 7, PVP material; Question 8, catheter needle; Question 9, flexible catheter; Question 10, PVP in special patients (newborns and the elderly).

The questions were assigned scores of 1, 1.5, and 2 points, according to the difficulty level. For questions that received one point, that is, those classified as having a lower degree of difficulty, the results of the pre- and post-tests were, respectively, 52.4% and 100% correct answers for Question 1; 57.1% and 90.5% for Question 7; 76.2% and 100% for Question 8; and 71.4% and 85.7% for Question 9. These figures show that the number of correct answers in the above questions improved after use of the hypermedia.

As far as questions worth 1.5 points, the number of correct answers in the pre- and post-test were, respectively, 61% and 82% for Question 3; 76.2% and 95.2% for Question 4; and 76.2% and 90.5% for Question 6. The number of correct answers after taking the course in relation to questions considered to have a medium level of complexity also increased.

For questions awarded two points, that is, with a higher degree of difficulty, the following results were achieved in terms of correct answers on the pre- and post-tests, respectively: 33.3% and 90.5% for Question 2; 28.6% and 33.3% for Question 5; and 61.9% and 85.7% for Question 10.

In all of the questions, the students obtained better results, as far as correct answers, on the post-test, in addition to achieving higher scores in terms of degree of difficulty of the questions posed. Questions 1 and 2 had a difference of 47.6% and 57.2%, respectively, between correct answers on the pre- and post-tests. This yielded the value $p<0.05$, which made the results of the study statistically significant and shows that the hypermedia wrought positive changes in the knowledge of students on the subject of PVP.

At the end of the post-test, the students had the opportunity to express their opinions about the hypermedia through suggestions and contributions to improve the suitability of the material. One of the points suggested by students was to increase the time to complete the course and another was related to difficulties in using the chat function. On the positive side, the students reported that there

was relevant information on the hypermedia about PVP that was often not discussed in the classroom, such as the size of the catheter that should be used, as well as local and systemic complications arising from the procedure.

In the overall analysis, the hypermedia was rated as "very good" and "good" by 92.3% and 7.7% of students, respectively. The hypermedia was deemed to be a resource that facilitates and complements the teaching-learning process.

DISCUSSION

In the world of higher education, new technologies have opened up numerous possibilities that can be used by students to build their own knowledge, as well as assist educators to direct their work, so that students can use ICT not only to receive information, but to think and create.[9]

The PVP hypermedia was built within this context of education, using different media resources that enabled it to optimize the teaching-learning process. It was validated by nursing and information technology specialists, in order to improve points considered to be important.

The content evaluation addressed the proposed objectives, which were intended to be clear and concise, in addition to the content presented, that is, the scope of the topic, the way in which the subject is presented, the implications of peripheral venipuncture for the practice of nursing, the accuracy of the theme presented, and the possibility of generating critical thinking.[10] The specialists found the hypermedia to be valuable and relevant for use by nursing students and validated the application of this resource in the teaching process. The suggestions and corrections recommended by the specialists were implemented, resulting in a final version of the hypermedia that is ready for use with undergraduate students.

Based on the literature, other aspects considered relevant for the construction of digital materials are organization, interpretation, and visualization, to make the material attractive and encourage reflection and the reformulation of knowledge.[11] In this study, the educational hypermedia followed a similar standard to provide these aspects in the modules, titles, and directional icons.

The technical evaluation took into account the efficiency, functionality, and usability of the resources and tools that were incorporated to promote the teaching-learning process. These resources were comprised of the images used, the quality of the videos, resources that promote interaction between participants, hyperlinks, and layout of the material.

To assess the virtual learning environment, the technical specialists also evaluated the response time, interface quality, tools, educational aspects, quality of the environment, and appropriate teaching resources for the environment.[12]

Another aspect evaluated was the amount of information placed on each screen, as well as presentation, which should make the information clear and easy to understand.[13] Font size and type, the choice of colors and the contrasts between them, were all considered relevant by the technical specialists.

Apart from the evaluation of the specialists, it is important to assess the impact of the use of ICT upon the population for which it is intended—that is, nursing students—in order to measure any changes that may have occurred in regard to learning.

The results of the post-test in this study indicated that the use of the hypermedia increased the number of correct answers and overall scores of the students on the subject of PVP as compared to the pretest. The differences were statistically significant and the results were satisfactory, in that students achieved better results after use of the educational strategy.

Similar to these findings, another study conducted with hypermedia showed that nursing students found this tool to be relevant for clinical practice, demonstrating that the use of this type of teaching resource encourages learning and has a significant impact upon the nursing profession.[14] Hypermedia provide an environment with faster access to information in various formats, along with freedom of access to knowledge.

Thus, with the advent of these technologies in education and the practice of nursing, it has been necessary to adapt pedagogical practices that enable more dialectical movement in the triangulation of professor, student, and object from the perspective of the educator as a facilitator in the teaching-learning process.[15] Therefore, technologies should be used in the teaching-learning process, because they promote the interactive formation of knowledge, in addition to permitting a broader view of the subject matter presented, constituting an individualized alternative for learning.[16]

Corroborating the findings of this study, another research project[11] also noted positive

results from the use of ICT with nursing students in the area of cardiology at Ain Shams University in Egypt. The study revealed statistically significant differences in the students' knowledge in the scores obtained in the post-test, in addition to positive feedback on ICT and in the promotion of independent learning.

Other researchers[15] who assessed the impact of conventional education and the use of ICT on 116 students in a medical surgical course subjected the students to four evaluations. The evaluation of the online intervention was performed with the VLE. A competitive method was applied to motivate student participation in the intervention. The gains in cognitive learning in the first evaluation were higher in the online educational proposal, with a significant difference compared to the conventional educational proposal ($p<0.05$). Knowledge retention was also observed in both groups during the 10-week follow-up period.

In a study conducted in São Paulo with nursing students enrolled in their first semester, the importance of integrating educational technologies to complement the training of nurses was assessed. Some of the positive points noted in the results include: the possibility of obtaining information beyond the realm of the classroom; greater communication between students, as well as between students and the professor; and the positive influence of the use of this resource in professional practice.[17]

Comparing the students before and after using the hypermedia revealed significant differences in regard to scores and correct answers to the questions from the evaluation—a point considered favorable for consolidation of the knowledge after the educational intervention. At the end of this educational strategy, positive changes were observed in relation to the acquisition and reinforcement of the knowledge of students about PVP.[12] Thus, the hypermedia had positive effects on the students and will soon be available in the course as a support to classroom teaching.

In this regard, the creation of these resources in nursing is very important for enhancing the profession and the quality of care, because it gives the participant autonomy and promotes a favorable teaching environment in the area of peripheral venipuncture.[18]

CONCLUSION

Given the reality of the use of technology in education, especially in the nursing field, this tool is important for disseminating information on the subject of PVP, in addition to providing support to nursing education through the use of ICTs within the academic environment, assisting the professor in the teaching of students and providing new strategies to complement classroom learning. In addition to this teaching benefit, the use of this hypermedia with undergraduate students will facilitate and bolster the practice of nursing in this area, contributing to the teaching-learning process and providing opportunities for future nurses to be qualified and able to promote health among the patients in their care.

The main limitation of the study is that the hypermedia only focused on one aspect of intravenous therapy - the peripheral venipuncture procedure. Therefore, it is suggested that complementary materials be designed, with the goal of providing more extensive nursing education in this area of expertise, not only for teaching purposes in the academic environment, but for extending it to professionals in health services in order to enhance their knowledge.

There is still much to be researched in the area of information and communication technology in order to learn how to build models that are appropriate to the practice of nursing. To this end, institutions of higher education need to create links with researchers to provide support in developing this kind of material, because the construction and maintenance process of these technologies is costly.

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Correspondence: Natasha Marques Frota
Rua Coronel Jucá, 291, ap. 103
60170-320 - Aldeota, Fortaleza, CE, Brasil
E-mail: enfanatashafrota@yahoo.com.br

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