

Construction and validation of a mobile application for development of nursing history and diagnosis

Construção e validação de aplicativo móvel para o desenvolvimento de histórico e diagnóstico de enfermagem
Construcción y validación de aplicación móvil para desarrollo de historia clínica y diagnóstico de enfermería

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ABSTRACT

Objectives: to describe the construction and validation process for a mobile application for development of the nursing history and diagnosis. **Methods:** methodological study conducted in 2018 in three stages: content creation, based on the Basic Human Needs categories and nursing diagnoses; content assessment by nine nursing judges, with calculation of the content validity index; and construction of the application, which included definition of the requirements, a conceptual map, implementation and prototyping options, tests and implementation. **Results:** the application was organized by sections: Grouped Basic Human Needs, Cranial pair tests, Clinical assessment scales and Additional tests. Two section were adjusted according to the judges' suggestions. **Final Considerations:** it is the first application produced in Brazil based on the Basic Human Need categories, which enables quick access to information, concepts and typical nomenclatures of semiology, recording of clinical data and definition of nursing diagnoses.

Descriptors: Physical Examination; Mobile Applications; Smartphone; Educational Technology; Nursing Process; Nursing Informatics.

RESUMO

Objetivos: descrever o processo de construção e validação de um aplicativo móvel para o desenvolvimento de histórico e diagnóstico de enfermagem. **Métodos:** estudo metodológico desenvolvido em 2018, em três etapas: elaboração do conteúdo, com base nas categorias das Necessidades Humanas Básicas e nos diagnósticos de enfermagem; avaliação do conteúdo por nove juízes enfermeiros com cálculo do índice de validade de conteúdo; e construção do aplicativo, que incluiu a definição dos requisitos, mapa conceitual, alternativas de implementação e prototipagem, testes e implementação. **Resultados:** o aplicativo ficou organizado em seções: Necessidades Humanas Básicas agrupadas, Exames dos pares cranianos, Escalas de avaliação clínica e Exames complementares. Duas foram readequadas conforme sugestão dos juízes. **Considerações Finais:** é o primeiro aplicativo produzido no Brasil pautado nas categorias de Necessidades Humanas Básicas que possibilita o acesso rápido a informações, conceitos e nomenclaturas típicas da semiologia, registro de dados clínicos e definição de diagnósticos de enfermagem.

Descritores: Exame Físico; Aplicativos Móveis; Smartphone; Tecnologia Educacional; Processo de Enfermagem.

RESUMEN

Objetivo: describir el proceso de construcción y validación de una aplicación para desarrollar la historia clínica y diagnósticos de enfermería. **Métodos:** estudio metodológico realizado en 2018 en tres etapas: elaboración de contenido, basado en categorías de Necesidades Básicas Humanas y diagnósticos de enfermería; contenido observado por nueve enfermeros evaluadores, con cálculo de índice de validez de contenido; construcción de aplicación, incluyendo definición de requisitos, mapa conceptual, alternativas de implementación y pruebas piloto, testeos, implementación. **Resultados:** se establecieron secciones en la aplicación: Necesidades Básicas Humanas agrupadas, Exámenes de los pares craneales, Escalas de evaluación clínica y Exámenes complementarios. Dos de ellas, reconvertidas por solicitud de los evaluadores. **Consideraciones Finales:** primera aplicación programada en Brasil para las categorías de Necesidades Básicas Humanas que permite rápido acceso a información conceptos y nomenclatura propia de la semiología, registro de datos clínicos y definición de diagnósticos de enfermería.

Descriptorios: Examen Físico; Aplicaciones Móviles; Teléfono Inteligente; Tecnología Educacional; Proceso de Enfermería; Informática Aplicada a la Enfermería.

INTRODUCTION

Technical and scientific improvement of the nursing process (NP) is an ongoing need among students and nurses, since it is the methodological tool that guides care and documentation in professional practice⁽¹⁻²⁾. The NP is comprised of the steps of collecting data or history, which includes the interview and physical examination; diagnosis; planning; implementation and nursing assessment⁽²⁻⁴⁾.

The NP needs to be based on a theoretical framework that safely and scientifically guides professional practice⁽²⁾. In Brazil, one of the most well-known and applied references is the Theory of Basic Human Needs (BHN), by Wanda Horta, which permits a holistic view of the patient and reinforces the importance of caring for human beings in relation to their psychobiological, psychosocial and psychospiritual needs^(2,5). The BHN can be associated with nursing problems discovered during clinical examinations, which may serve as data for selecting the nursing diagnoses described by taxonomies, such as NANDA International (NANDA-I)⁽⁴⁻⁵⁾.

Despite the importance of physical examinations, it can be noted that they are not fully carried out in a systematic way by students and nurses in health institutions. Studies indicate that lack of theoretical-practical skills, gaps in the teaching-learning process, forgetting theoretical support and difficulty learning the typical codification of the health area are the main factors that hinder their being performed, impacting the operationalization of the NP, which is essential for scientificity and visibility of the profession^(2,87-11).

In this context, it is encouraged to develop new ways of teaching that facilitate and incite students to learn and apply the knowledge in practice, such as educational technologies⁽¹¹⁾. Among them, mobile device applications stand out for overcoming the limitations of mobility, since smartphones are a pocket computer that can accompany users 24 hours a day. This quality is essential for resources used in health care⁽⁸⁻¹²⁾, including those that support development of the NP.

When looking for nursing applications, in Google Play Store and Apple Store, no "tool" was found for clinical examinations of adults that uses nursing taxonomy in its organization. Therefore, this study was developed based on the premise of the importance of interviews and physical examinations for providing care, since they allow students and nurses to collect subjective and collective patient data and, from this data, select the needs that require nursing care and determine the representative diagnoses through reason and clinical judgment.

OBJECTIVES

To describe the construction and validation process of a mobile application for the development of nursing history and diagnosis.

METHODS

Ethical aspects

The research project was submitted to the Ethics and Research Committee of the UFES Health Sciences Center, under CAAE No.

69927917.6.0000.5060, and was approved on August 2, 2017, under Opinion No. 2.199.211.

Type of study

Methodological study carried out from June to August 2018. The Standards for Reporting Qualitative Research (SRQR)⁽¹³⁾ were used for producing the research report.

Methodological procedures

The study was developed based on the user-centered design method, in accordance with the standard ABNT ISO/TR 16982:2014⁽¹⁴⁾, in three stages: 1) Content development; 2) Content assessment; and 3) Construction of the application.

Study site

Federal University of Espírito Santo (UFES), Vitória, ES.

Source, collection and organization of the data

In the first stage, the contents of interest supported by the application were selected. Based on the experience of the researchers, nursing articles and textbooks on physical examinations, semiology, BHN and classification of nursing diagnoses from NANDA-1 were used.

To organize the content, the BHN with convergent content were grouped by the researchers in order to reduce the number of categories, which enabled the content of the physical examination to be organized in a head-to-toe assessment sequence. Next, the main NANDA-1 nursing diagnoses that were related to the content of the physical examination listed in each BHN group were selected. Diagnoses for children were excluded since the technology is intended for adults.

In the second stage, to actively include the users in the creation of the application, the content validation process by judges took place. There is no established standard in the literature regarding the criteria for defining judges and no consensus in relation to the necessary number of individuals for the validation stage⁽¹⁵⁾. However, it is important to select nurses with clinical experience and theoretical knowledge of the topic studied⁽¹⁵⁻¹⁶⁾. Therefore, in this study, the judges were selected on the basis of the following inclusion criteria: be a nurse and have worked in the profession for at least two years as a semiology professor, have experience using NANDA-1 taxonomy and a minimum degree of specialist.

The snowball technique was used for recruitment: judges from the relational universe of the researchers were invited who, in turn, indicated other nurses to form the panel of assessors. The nine selected judges received an invitation letter, informing them about the study, assurance of anonymity and the possibility of withdrawing from the study at any time. If in agreement, they signed a free and informed consent form and also received the research instruments, one for characterization and the other for analysis of the content in reference to the BHN, the physical examination and NANDA-1 diagnoses titles, which needed to be returned within 15 days.

The characterization instrument was composed of the following variables: sex, age, state in which they worked, degree, length of time since graduation, length of time as a semiology professor, and use of NANDA-1 in clinical and/or teaching practice. In the assessment instrument, the content was distributed in the following order: grouping of BHN, semiology content, main findings and NANDA-1 diagnoses. The judges were requested to assess the content based on the criterion of adequacy and mark one of the following options: adequate; needs adjustment; inadequate. For items deemed inadequate or needing adjustment, they were able to provide their reasons and suggestions to modify and/or exclude. Three authors with semiology teaching experience of more than five years honed the content and structured the content of the application.

The application construction stage was carried out in four steps as proposed by the user-centered design method⁽¹⁴⁾: 1) Definition of requirements and creation of the conceptual map of the application; 2) Generation of implementation and prototyping options; 3) Tests; and 4) Implementation. Given the specificity of the knowledge of the technologies required to finalize the desired product, a partnership was formed with teams from the Design Ontology Laboratory and Observatory (LOOP) and Laboratory of Nursing and Health Technologies (Cuidar Tech), both at UFES.

Data analysis

Each item from the assessment instrument was scored by the judges on a 3-point Likert scale (1 - adequate; 2 - needs adjustment; 3 - inadequate). Then, the content validity index (CVI) was calculated to estimate the degree of agreement among the judges. According to the literature⁽¹⁷⁾, in the range of six or more judges, the items assessed should have a CVI greater than or equal to 0.79; thus, items with a CVI lower than 0.79 were adjusted according to the suggestions. The data was organized and analyzed on an electronic spreadsheet from Microsoft Office Excel[®] version 2010.

The content validated by the judges was used as the basis for producing the text of the screens, corrected by the Re-readers Group from the Department of Languages and Literature and the Graduate Studies Program in Linguistics of UFES. It was also used for creating the conceptual map of the application.

Based on the conceptual map, implementation and prototyping options were generated, using the framework Apache Cordova⁽¹⁸⁾, for the functionalities of the application organized into interactive design cycles. Whenever, possible, free and open technologies were adopted⁽¹⁴⁾. The tests were carried out by the LOOP team during the development of the application, with the usability standard and heuristics developed by Nielsen⁽¹⁸⁾ and Krone⁽¹⁹⁾. After corrections and adjustments, the application was registered with the Technology Innovation Institute of UFES.

RESULTS

The application developed, called CuidarTech Semio – Nursing Clinical Examination, was organized into 17 sections: General instructions; Patient identification; 12 sections in reference to the grouped BHN with content from the interview and physical examination related to the main NANDA-1 diagnosis titles; Cranial pair tests, Clinical assessment scales; and Additional tests.

The application's content was validated by nine nursing professors (seven of whom were women), with more than five years of education and a mean age of 42.4 years. Only one had a specialization as the highest maximum degree; the others held a PhD (n=5) and master's degree (n=3). Six judges reported having two to five years of teaching experience in the discipline of semiology, and the other three from 10 to 36 years. All had practical clinical and teaching experience in the use of the diagnoses according to the taxonomy of NANDA-1.

Of the 17 sections assessed by the judges, only two had a CVI lower than 0.79. Therefore, their content was adjusted as per the suggestions. In the section "General instructions", it was requested to replace the term "health professionals" with "nurses", emphasizing that the objective of the application was to assist nursing students and nurses to perform physical examinations. Another suggestion was to add the rhinoscope, commonly used for inspecting the anterior and posterior nasal cavities, to the list of materials and equipment.

In the section "Skin and mucous membrane integrity; cell growth and hormonal regulation", the judges suggested adding content to assess nails in terms of their form, configuration, thickness, consistency, surface and color, in addition to content on laryngeal masks, port-a-caths and epidural catheters. After the content validation, the application was organized as described in Chart 1.

Chart 1 - Description of the content of the sections of the CuidarTech Semio – Nursing Clinical Examination application, organized through grouping basic human needs, Vitória, Espírito Santo, Brazil, 2018

BHN/Sections	Related content
1. General instructions	Presents information on the use and objective of the application; physical examination concept; NANDA-1 taxonomy; Wanda Horta and categorization of Basic Human Needs (BHN); materials; equipment and techniques used in the nursing interview and physical examination; and Nursing Technologies Laboratory – CuidarTech.
2. Patient identification	For filling in the following information: health institution; patient's name; time; date; sector; bed; address; contact; email; reason for hospitalization; current complaint; medical diagnosis; interviewee; examiner; marital status; and general observations.
3. Communication, body care, self-image, self-esteem and locomotion	For assessing facial expression, communication and locomotion of the patient, completion of the Morse fall scale and description of how the patient feels.
4. Therapeutics, immunology, acceptance, learning, religious or theological, ethics or philosophy of life	For filling out the following information: medications used; vaccinations taken; allergy to drugs and other substances; surgical and clinical history; previous hospitalizations; current and past chemical dependency; acceptance of the diagnosis and therapy; history of family disease; level of instruction; ability to learn new words and challenges; religiosity and beliefs; and observations of the assessor.
5. Safety, dwelling, environment, space, self-realization, love, sociability, freedom, leisure, recreation, physical activity/exercise; sleep and rest	For filling in the following information: housing; profession/occupation; family life; social ties; leisure activities; and quality of sleep/rest.

To be continued

Chart 1

BHN/Sections	Related content
6. Neurological regulation, orientation in space and time, attention	For assessing level of consciousness (Glasgow coma scale); content of consciousness; orientation; recent and distant memory; anxiety; sadness; thoughts; and coordination, balance and sensitivity, through tests.
7. Thermoregulation; vascular; oxygenation and pain perception	For assessing body temperature; pulse; respiration; oxygen saturation; blood pressure; and pain (pain scale).
8. Nutrition, hydration, hydrosaline and electrolytic regulation	For assessing weight; height; body mass index; waist, abdominal and hip circumference; waist-to-hip ratio; eating habits; and water balance.
9. Skin and mucous membrane integrity; cell growth and hormonal regulation	For assessing tegument; presence of drains and catheters; injury risk (Braden scale); head; face; neck; trachea; thyroid and lymph nodes.
10. Auditory and visual perception	For assessment of the ear (symmetry, secretion, edema, pain, signs of inflammation and tympanic membrane - otoscopy); eyes (eyebrows, eyelids, eyeballs, eyelashes, conjunctiva, cornea, lens, retina, sclera, iris, pupils and lacrimal apparatus); application of Rinne and Weber tests, optic nerve, examination of cardinal points, corneal-eyelid reflex, Bobinsk test.
11. Smell and taste perception	For assessment of the nose (symmetry, skin, foreign bodies, nasal conchae, septum, vibrissae, secretion, texture, bone structure, maxillary and frontal sinus, transnomination); mouth (integrity, color, hydration, teeth and gums, oral mucosa, salivary ducts, palate, uvula, breath, tonsils); application of nerve tests: olfactory, glossopharyngeal, trigeminal, hypoglossal, facial and glossopharyngeal.
12. Vascular and oxygenation	For assessment of the precordium (collateral circulation, ictus cordis, tremor, pulse rate and rhythm, cardiac auscultation - sounds and murmurs); neck (jugular vein distention, hepatojugular reflux, carotid arteries); peripheral vascularity (signs of arterial insufficiency - pain, skin, reflex hyperemia of the lower limbs, pulse, Allen's test - and of venous insufficiency - lower mobility in clogged calf compared to the other calf, Homans sign, Godet's sign); chest (shape, collateral circulation, type of breathing, chest expansion, tactile fremitus, percussion, diaphragmatic excursion, respiratory sounds, adventitious sounds).
13. Motility, elimination and sexuality	For assessment of the abdomen (shape, symmetry, collateral circulation, skin, pulse, peristalsis, liver, splenic dullness, superficial and deep palpation, Blumberg's sign, flick test, Giordano's sign, spleen, aorta); breasts; external female genitalia; male genitals.
14. Locomotion and body mechanics	For assessing the upper and lower limbs (symmetry, circumference, length, skin color, edema, temperature, injuries or deformities, bone and muscle structure, pain, range of motion - shoulder, elbow, wrist and hand, hip, knee, ankle joints).
15. Cranial nerves	Quick access by users to the examinations related to the 12 pairs of cranial nerves.
16. Scales	Quick access by users to the Braden, Morse and Glasgow scales and the visual analog scale for pain.

To be continued

Chart 1 (concluded)

BHN/Sections	Related content
17. Additional tests	Designed for filling in test results: X-ray, MRI, electrocardiogram, ultrasound, serum tests, urinalysis, parasitology, pet scan, computed tomography, mammography, vascular doppler, scintigraphy, bone densitometry, culture (microbiology) and others.

The textual organization presented in Chart 1 illustrates the content of each screen of the application, in accordance with the conceptual map presented in Figure 1.

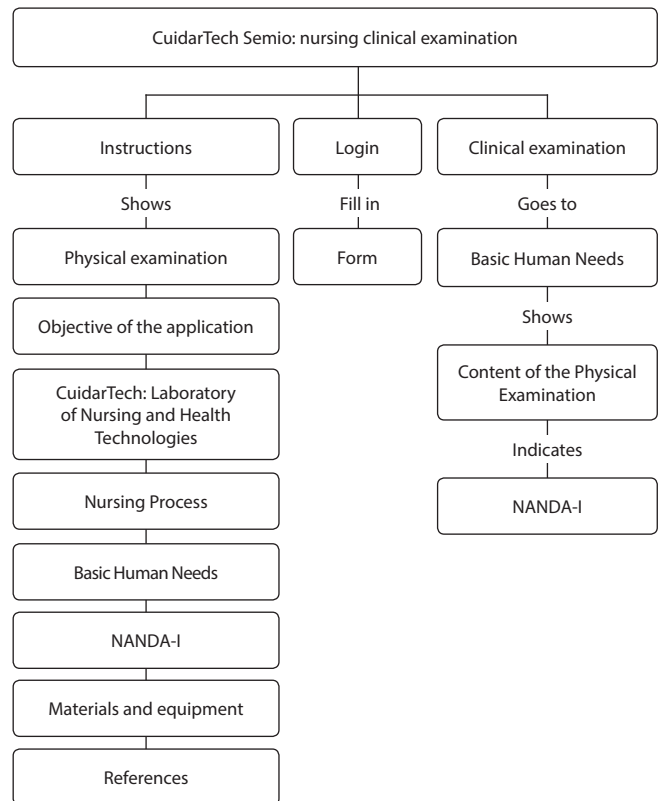


Figure 1 - Conceptual map of the CuidarTech Semio – Nursing Clinical Examination application, Vitória, Espírito Santo, Brazil, 2018

To use the application, users must select one of the six options presented on the home page menu: Clinical Examination, Cranial Nerves, Scales, Nursing Process, Objective and CuidarTech, and References. By clicking on Clinical Examination, the Patient Identification and BHN options appear. Clicking on Patient Identification brings up the items to be filled out for registering the patient; and by clicking on the Start Examination option, the data is automatically recorded for subsequent consultation. The user is then directed to a screen that presents the sections for patient assessment according to the BHN and can choose one of the BHN groupings to start the clinical examination (Figure 2).

After choosing a grouping, the users fill out the data requested in each section and, upon completion, can choose to proceed to the next grouping, return to the previous one or generate possible NANDA-1 nursing diagnoses related to the selected grouping. It should be mentioned that the application is flexible and allows users to continue the process even without filling out any field.

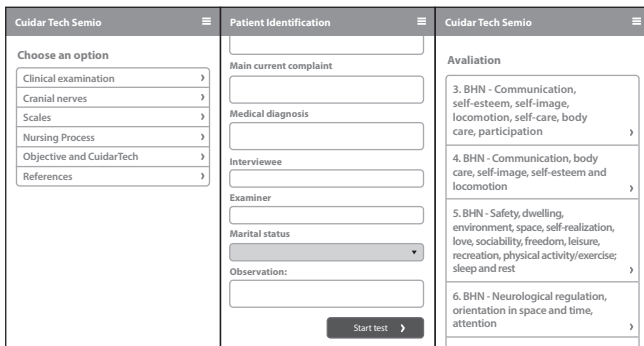


Figure 2 – Home screen, patient identification screen and assessment screen of the basic human needs groupings of the CuidarTech Semio – Nursing Clinical Examination application, Vitória, Espírito Santo, Brazil, 2018

When choosing the Cranial Nerves section on the home screen, a new screen opens which enables selecting the nerve to be assessed and, after selection, displays the description of the specific examination to be performed. The Scales section, when chosen, results in a new screen listing four scales that can be selected, giving access to the corresponding assessment items.

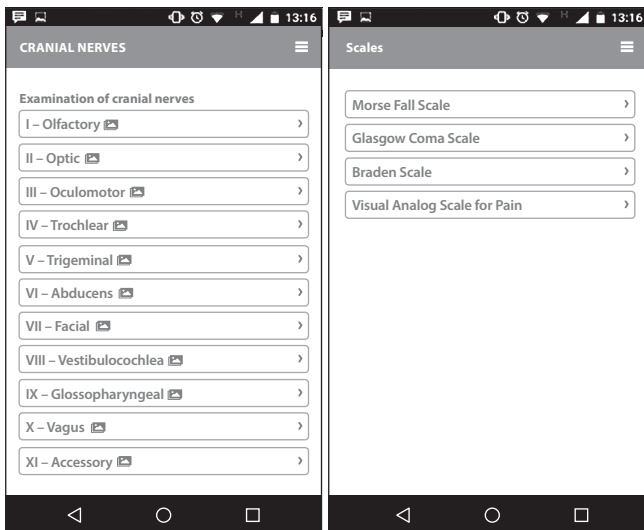


Figure 3 – Cranial Nerves and Scales Screens of the CuidarTech Semio – Nursing Clinical Examination application, Vitória, Espírito Santo, Brazil, 2018

The Nursing Process, Objective and CuidarTech options, presented on the home screen, gives access to new screens that list their respective items which, when selected, display their descriptive content.

In the testing stage, the developers inspected the entire system using heuristics as a guide, and no problems were detected. After the validation stage and correction of the content by the judges, the application was registered with the Technological Innovation Institute of UFES.

DISCUSSION

Educational technologies are defined as the set of technological resources developed on the basis of a scientific method, to facilitate the day-to-day lives of people in various fields of knowledge⁽²⁰⁾. They have been increasingly used in health training, since they

are mediators of the teaching-learning process, provide greater flexibility in teaching not restricted by temporal or geographic limits and support new, nontraditional learning methods that overcome the limits of classroom-based teaching⁽²¹⁾.

In this context, digital technologies are noteworthy, especially mobile devices which are increasingly common in the daily lives of health students and nurses and help develop clinical skills, reasoning and judgment, make classes more dynamic and promote problem-solving attitudes^(8,21-22).

A study conducted in 2017, which sought to describe the construction of a mobile educational and follow-up device for patients with peripheral arterial disease, found that the technology is beneficial for monitoring the evolution of the disease and assisted in patient self-care. It is also helpful for monitoring risk factors, co-participation of patients in their disease and treatment, reducing health system costs through the adoption of better lifestyles⁽²³⁾. Other advantages of the use of mobile applications in health were cited by researchers⁽¹⁰⁾ after constructing an application for teaching about vital signs, such as facilitating the learning of typical new nomenclatures in the field of health and encouraging the development of clinical reasoning through decision-making based on clinical findings.

CuidarTech Semio – Nursing Clinical Examination represents a technological innovation in health, since it was the first mobile application in Brazil developed using the BHN categories proposed by Wanda Horta. This assertion is reinforced by the results of the literature review. In an analysis of the contributions of using digital educational technologies for teaching nursing skills, there were no technologies that used the BHN as part of the construct⁽²⁻²³⁾.

To ensure greater accuracy in the content validation of the proposed technology, judges were selected with experience teaching semiology and in the use of NANDA-1 taxonomy, as recommended in the literature⁽¹⁵⁾. This was crucial for adding highly valuable content for nursing practices, such as the inclusion of the rhinoscope in the list of materials and equipment, an instrument used to inspect the anterior and posterior nasal cavities⁽²⁴⁾. Information on nail assessment and laryngeal masks, port-a-caths and epidural catheters was also included.

Nails are structures attached to the skin that serve to protect the tips of the fingers and toes from trauma⁽²⁶⁾. Through them, nurses can detect important information in the physical examination, such as brittle and concave nails, which suggest iron deficiency; jagged, bitten and dirty nails are indicative of nervousness and poor hygiene; clubbing is suggestive of cyanotic heart disease, emphysema and chronic bronchitis; and cyanotic nails may indicate cardiovascular and respiratory dysfunction⁽²⁵⁾.

As for the devices suggested by the judges, it is important to point out that one of the duties of nurses during physical examinations is the monitoring, handling and recording of devices and drains on the skin of patients⁽²⁶⁾. Laryngeal masks are an important tool for managing difficult airways during cardiopulmonary resuscitation⁽²⁵⁻²⁶⁾. A randomized controlled study, with nursing students from a public university in the State of São Paulo, found that it was extremely important to include the use of laryngeal masks in simulations of emergency practices, since a number of the students did not know their purpose or how to use them⁽²⁷⁾.

Port-a-caths (totally implanted central venous catheter) are intended to ensure safe, long-term administration of intravenous

drugs, such as chemotherapy for cancer patients. A field study, conducted with ten cancer nurses from a hospital in Teresina-PI, found that care technologies (port-a-cath) are readily adopted by nurses. However, a factor predominantly reported among the researchers was lack of instruction on the topic in university courses⁽²⁸⁾, which underscores the importance of including this device in the proposed content.

Epidural catheters, also indicated by the judges, promote postoperative pain control and relief. Nursing teams play a vital role in relation to this device, such as assessing the conditions of the dressing and catheter insertion site, avoiding accidental movement and monitoring possible complications, such as abscesses, hematomas and shifts to the subarachnoid space⁽²⁹⁻³⁰⁾.

It should be emphasized that a conceptual map was created for constructing the application – a highly relevant pedagogical strategy in the formulation of scientific concepts that facilitates the listing of information and imparts meaning to what is being studied⁽³¹⁾. It also generated implementation and prototyping options, tests and implementation, which are important stages in the construction of mobile applications, since they facilitate interaction and ensure user-centered design, according to usability needs⁽¹⁴⁾. These strategies were used by Vêscovi et al.⁽³²⁾ when building a mobile application to assess the feet of people with diabetes mellitus.

Limitations of the study

Since this is a beta version, it is still in the development stage, but is considered acceptable to be launched to the public. Adjustments may be made based on the intelligibility and clinical validation stages, to verify essential attributes such as clinical relevance, feasibility and reliability.

Contributions to the field

CuidarTech Semio – Nursing Clinical Examination represents a technological innovation for health, since it is the first mobile

application produced in Brazil based on BHN categories. It is designed for all levels of health care and enables quick access to accurate information, concepts and typical nomenclatures of semiology, recording of clinical data and formulating nursing diagnoses consistent with the needs of each patient. It is, therefore, an up-to-date educational and professional tool which assists students and nurses in carrying out the first stage of the nursing process and for making clinical judgments, enables data to be collected anywhere, 24 hours a day, and promotes acquisition of scientific knowledge and clinical reasoning. In addition, this application may contribute to day-to-day teaching and nursing practices since, due to the complexity of the content, it provides students and nursing professionals with an up-to-date tool that will guide them in performing their duties by diagnosing possible risks, promoting health and solving nursing problems.

FINAL CONSIDERATIONS

This study described the development of the CuidarTech Semio – Nursing Clinical Examination application, designed for nursing students and nurses, to help them carry out the first two stages of the nursing process: nursing history and nursing diagnoses. Its content groups theoretical information and practical procedures related to anamneses and physical examinations, in accordance with BHN groupings, in addition to listing the main NANDA-1 titles and diagnoses. It was deemed to be a reliable and adequate tool, according to the assessment of the judges. In the future, it is intended to conduct implementation/application studies to assess the impacts from use of the product.

Considering the technical knowledge for constructing the application, the contribution of the design team was noteworthy, due to the importance of interdisciplinary production.

It is hoped that this study will arouse the interest of other nurses for developing new technologies that align theoretical knowledge with nursing practices, in an effort to enhance the quality of care provided.

REFERENCES

1. Martins MCT, Chianca TCM. Construção de um software com o processo de enfermagem em terapia intensiva. *J Health Inform* [Internet]. 2016 [cited 2018 Feb 5];8(4):119-25. Available from: <http://www.jhi-sbis.saude.ws/ojs-jhi/index.php/jhi-sbis/article/view/420/274>
2. Conselho Federal De Enfermagem – COFEN. Resolução COFEN n. 358, de 15 de outubro de 2009. Dispõe sobre a Sistematização da Assistência de Enfermagem e a implementação do Processo de Enfermagem em ambientes, públicos ou privados, em que ocorre o cuidado profissional de Enfermagem, e dá outras providências [Internet]. Brasília: COFEN; 2009 [cited 2018 Mar 14]. Available from: http://www.cofen.gov.br/resoluco-cofen-3582009_4384.html
3. Errico LSP, Bicalho PG, Oliveira TCFL, Martins EF. The work of nurses in high-risk prenatal care from the perspective of basic human needs. *Rev Bras Enferm*. 2018;18(71):1335-43. doi: 10.1590/0034-7167-2017-0328
4. Herdman HT, Kamitsuru S (Ed). NANDA International, Inc. *Nursing diagnoses: definitions and classification 2018–2020*. 11 ed. New York: Thieme; 2018.
5. Camacho ACLF, Joaquim FL. Reflections based on Wanda Horta on the basic instruments of nursing. *Rev Enferm UFPE*. 2017;11(13):5432-8. doi: 10.5205/1981-8963-v11i12a23292p5432-5438-2017
6. Nóbrega RV, Nóbrega MML, Silva KL. Diagnósticos, resultados e intervenções de enfermagem para crianças na Clínica Pediátrica de um hospital escola. *Rev Bras Enferm*. 2011;64(3):501-10. doi: 10.1590/S0034-71672011000300014
7. Silva Jr MG, Araújo EC, Moraes CRS, Gonçalves LHT. Software for systematization of nursing care in medical units. *Rev Bras Enferm*. 2018;71(5):2425-31. doi: 10.1590/0034-7167-2016-0386

8. Lira ALBC, Fernandes MICD, Costa IA, Silva RSC. Estratégia de aprimoramento do ensino do exame físico. *Enferm Foco* [Internet]. 2015 [cited 2018 May 22];6(1):57-61. Available from: <http://revista.cofen.gov.br/index.php/enfermagem/article/view/578/260>
9. Majczak JA, Hohl M. Exame físico de enfermagem do idoso hospitalizado. *Cogitare Enferm* [Internet]. 2015 [cited 2018 May 14];20(2):314-24. Available from: <https://revistas.ufpr.br/cogitare/article/view/39888/25538>
10. Pereira FGF, Silva DV, Sousa LMO, Frota NM. Building a digital application for teaching vital signs. *Rev Gaúcha Enferm* [Internet]. 2016 [cited 2018 Jan 16];37(2):e59015. Available from: <https://seer.ufrgs.br/RevistaGauchadeEnfermagem/article/view/59015/37574>
11. Melo GSM, Tibúrcio MP, Freitas CCS, Vasconcelos QLDAQ, Costa IKF, Torres GV. Semiotics and semiology of Nursing: evaluation of undergraduate students' knowledge on procedures. *Rev Bras Enferm*. 2017;70(2):249-56. doi: 10.1590/0034-7167-2016-0417
12. Domingos CS, Boscarol GT, Souza CC, Tannure MC, Chianca TMC, Salgado PO. Adaptation of software with the nursing process for innovation units. *Rev Bras Enferm*. 2019;72(2):400-7. doi: 10.1590/0034-7167-2018-0579
13. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA (2014). Standards for Reporting Qualitative Research. *Acad Med*. 2014;89(9):1245-51. doi:10.1097/acm.0000000000000388
14. Associação Brasileira de Normas Técnicas – ABNT. ISO/TR 16982:2014. Ergonomia da interação humano-sistema — Métodos de usabilidade que apoiam o projeto centrado no usuário. Rio de Janeiro: ABNT; 2014.
15. Lopes MVO, Silva VM, Araújo TL. Methods for establishing the accuracy of clinical indicators in predicting nursing diagnoses. *Int J Nurs Knowl*. 2012;23(3):134-9. doi: 10.1111/j.2047-3095.2012.01213.x
16. Carvalho CMG, Cubas MR, Nóbrega MML. Brazilian method for the development terminological subsets of ICNP®: limits and potentialities. *Rev Bras Enferm*. 2017;70(2):430-5. doi: 10.1590/0034-7167-2016-0308
17. Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Res Nurs Health*. 2007;30(4):459-67. doi: 10.1002/nur.20199
18. Nielsen J. Heuristic evaluation. In Nielsen J, Mack RL (Eds.). *Usability Inspection Methods*. New York, NY: John Wiley & Sons; 1994. p. 137-202.
19. Krone C. Validação de heurísticas de usabilidade para celulares touchscreen. Florianópolis: Grupo de Qualidade de Software, Universidade Federal de Santa Catarina; 2013.
20. Pereira IM, Bonfim D, Peres HHC, Góes RF, Gaidzinski RR. Mobile application for data collection in health research. *Acta Paul Enferm*. 2017;70(2):430-5. doi: 10.1590/1982-0194201700069
21. Silveira MS, Cogo ALP. The contributions of digital technologies in the teaching of nursing skills: an integrative review. *Rev Gaúcha Enferm*. 2017;38(2): e66204. doi: 10.1590/1983-1447.2017.02.66204
22. McCutcheon K, Lohan M, Traynor M, Martin D. A systematic review evaluating the impact of online or blended learning vs. face-to-face learning of clinical skills in undergraduate nurse education. *J Adv Nurs*. 2015;71(2):255-70. doi: 10.1111/jan.12509
23. Mendez CB, Salum NC, Junkes C, Amante LN, Mendez CML. Mobile educational follow-up application for patients with peripheral arterial disease. *Rev Latino-Am Enfermagem*. 2019;27:e3122. doi: 10.1590/1518-8345.2693-3122
24. Barros ALBL. *Anamnese e Exame Físico - Avaliação Diagnóstica de Enfermagem no Adulto*. 3 ed. Porto Alegre: Artmed; 2016.
25. Barbosa ML, Brito ED, Teixeira IA, Nassif PW. Uma lição de clínica médica através das unhas: lesões ungueais relacionadas a doenças sistêmicas. *Braz J Surg Clin Res* [Internet]. 2013 [cited 2019 Apr 01];4(1):75-8. Available from: https://www.mastereditora.com.br/periodico/20130731_225255.pdf
26. Sousa GGS, Pascoal LM, Nunes SFL, Lima Neto PM, Santos FDRP, Santos Neto M, et al. Nursing outcome "airway permeability" in postoperative patients. *Rev Bras Enferm*. 2020;73(3):e20180355. doi: 10.1590/0034-7167-2018-0355
27. Pedersoli CE, Pedersoli TAM, Faro ACM, Dalri MCB. Teaching airway management with laryngeal mask: randomized controlled trial. *Rev Bras Enferm*. 2016 Apr;69(2):368-74. doi: 10.1590/0034-7167.2016690221i
28. Pires NN, Vasques CI. Nurses' knowledge regarding the handling of the totally-implanted venous access device. *Texto Contexto Enferm*. 2014;23(2):443-50. doi: 10.1590/0104-07072014000830013
29. Taets GGC, Figueiredo NMA. A quasi-experimental nursing study on pain in comatose patients. *Rev Bras Enferm*. 2016;69(5):871-6. doi: 10.1590/0034-7167-2015-0121
30. Fernandes CR, Fonseca NM, Rosa DM, Simões CM, Duarte NMC. Recomendações da Sociedade Brasileira de Anestesiologia para Segurança em Anestesia Regional. *Rev Bras Anesthesiol* [Internet]. 2011 [cited 2019 Apr 01];61(5):668-94. Available from: <http://www.scielo.br/pdf/rba/v61n5/v61n5a16.pdf>
31. Carvalho DPSRP, Vitor AF, Cogo ALP, Bittencourt GKGD, Santos VEP, Ferreira Jr MA. Critical thinking in nursing students from two Brazilian regions. *Rev Bras Enferm*. 2020;73(1):e20170742. doi: 10.1590/0034-7167-2017-0742
32. Vêscovi SJB, Primo CC, Sant'Anna HC, Bringuete MEO, Rohr RV, Prado TN et al. Mobile application for evaluation of feet in people with diabetes mellitus. *Acta Paul Enferm*. 2017;30(6):607-13. doi: 10.1590/1982-0194201700087