

ORIGINAL ARTICLE

APP TO EVALUATE THE LEVEL OF CONSCIOUSNESS IN ADULTS: TECHNOLOGICAL PRODUCTION IN NURSING*

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ABSTRACT

Objective: to develop an app for assessing the level of consciousness in adults.

Method: technological production, structured from the theoretical framework of problem-based learning methodology and developed considering the steps of contextualized instructional design (analysis, design, development, evaluation). Study conducted at the Federal University of Santa Catarina, from May 2014 to April 2015.

Results: the app presents the contents: scales for evaluation of the level of consciousness, pupillary evaluation, reflexes and breathing pattern, presented to the users through short texts with brief explanations, images and videos.

Conclusion: the app can facilitate the study of the theme at any time or place, even allowing its application at the bedside, thus contributing to improvements in teaching, care and safety of critically ill patients. The results of the evaluation of the technology by teachers and students will be the object of future studies.

DESCRIPTORS: Information technology in nursing; Biomedical technology; Technological development; Consciousness disorders; Nursing.

*Article derived from the doctoral thesis "Mobile app for avaluation of level of conscience in adults (OMAC)". Federal University of Santa Catarina, 2015.


HOW TO REFERENCE THIS ARTICLE:


Barros WCTS, Dal Sasso GTM, Alvarez AG, Ramos SF, Martins SR. App to evaluate the level of consciousness in adults: technological production in nursing. *Cogitare enferm.* [Internet]. 2019 [access "insert day, month and year"]; 24. Available at: <http://dx.doi.org/10.5380/ce.v24i0.60338>.





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APLICATIVO PARA AVALIAÇÃO DO NÍVEL DE CONSCIÊNCIA EM ADULTOS: PRODUÇÃO TECNOLÓGICA EM ENFERMAGEM

RESUMO

Objetivo: desenvolver um aplicativo para a avaliação do nível de consciência em adultos.
Método: produção tecnológica, estruturada a partir do referencial teórico da metodologia da aprendizagem baseada em problemas e desenvolvido considerando os passos do design instrucional contextualizado (análise, design, desenvolvimento, avaliação). Estudo realizado na Universidade Federal de Santa Catarina, de maio de 2014 a abril de 2015.
Resultados: o aplicativo apresenta os conteúdos: escalas para avaliação do nível de consciência, avaliação pupilar, reflexos e padrão respiratório, apresentados aos usuários por meio de textos curtos com breves explicações, imagens e vídeos.
Conclusão: o aplicativo pode facilitar o estudo sobre a temática em qualquer hora ou local, permitindo inclusive sua aplicação à beira do leito, contribuindo assim para melhorias do ensino, assistência e segurança de pacientes em estado crítico. O resultado da avaliação da tecnologia por docentes e estudantes será objeto de estudos futuros.

DESCRITORES: Informática em enfermagem; Tecnologia biomédica; Desenvolvimento Tecnológico; Transtornos da consciência; Enfermagem.

APLICACIÓN PARA EVALUACIÓN DEL NÍVEL DE CONSCIENCIA EN ADULTOS: PRODUCCIÓN TECNOLÓGICA EN ENFERMERÍA

RESUMEN

Objetivo: desarrollar una aplicación para analizar el nivel de consciencia en adultos.
Método: producción tecnológica, estructurada por medio del referencial teórico de la metodología de aprendizaje basada en problemas, la cual se desarrolló considerando los pasos del diseño educacional contextualizado (análisis, design, desarrollo, evaluación). Estudio que se realizó en la Universidad Federal de Santa Catarina, de mayo de 2014 a abril de 2015.
Resultados: la aplicación presenta los contenidos: escalas para evaluación del nivel de consciencia, evaluación pupilar, reflejos y patrón respiratorio, presentados a los usuarios por medio de textos cortos con breves explicaciones, imágenes y videos.
Conclusión: la aplicación puede facilitar el estudio acerca de la temática en cualquier hora o local, posibilitando incluso su uso en el lecho, lo que contribuye para mejoras de la enseñanza, asistencia y seguridad de pacientes en condición crítica. El resultado de la evaluación de la tecnología por docentes y estudiantes será objeto de estudios futuros.

DESCRIPTORES: Informática en enfermería; Tecnología biomédica; Desarrollo tecnológico; Trastornos de la consciencia; Enfermería.

INTRODUCTION

With the growing technological evolution, innovations and improvement in the context of nursing and healthcare teaching are required. The importance of the development of Information and Communication Technologies (ICTs), in order to collaborate in learning and updating knowledge, can be observed. The use of these technologies has brought about changes in the ways of teaching, learning and providing care⁽¹⁾.

Among the factors driving these changes is the rapid technological advance, especially of mobile objects. In a study conducted by the Brazilian Institute of Geography and Statistics, it was found that 92.1% of the Brazilian population use smartphones as the main source of access to information⁽²⁾.

Linked to this reality, it should also be highlighted that mobile apps that cover multiple uses are being studied, developed and used by healthcare providers. These tools enable the improvement of the users' capacity to implement evidence and stimulate clinical reasoning and critical thinking⁽³⁾.

The explicit reasons for the increased use of apps by healthcare providers are related to patient safety, due to the availability of knowledge in a fast and comprehensive way, with current clinical guidelines, which can aid in the deliberation of their interventions and improve healthcare⁽⁴⁾.

It is considered that the impact of mobile technology has changed the way individuals interact, including in their social context, being reflected in the teaching-learning theory and practice. Thus, the incorporation of apps into the lives of teachers and students has innovative effects, with educational methods that complement and associate theory and practice⁽⁵⁻⁶⁾.

Nursing professionals and nursing students in the hospital environment encounter difficulties seeking knowledge due to their extensive workload and the impossibility of participation in continuous education practices. Considering this context, the use of mobile apps is an important tool to stimulate the implementation of evidence-based practices, the promotion of critical thinking, the dissemination of knowledge, problem solving, the integration of theory and practice, and the interaction between staff and teachers⁽⁷⁾.

The benefits of using mobile apps and their national and international growth have been evidenced by recent studies. The interest of nursing professionals in technological resources, in order to improve healthcare and to promote the quality of this care, has been highlighted⁽⁸⁾.

The evaluation of the level of consciousness is part of the care for the critically ill patient, therefore, it is essential that the professionals are knowledgeable on this subject. It is extremely important for nursing care to be safe and effective, therefore the construction of mobile technologies allows the analysis of the evolution of assisted patients, improves clinical thinking, and provides rapid access to information⁽⁹⁻¹⁰⁾.

In an effort to share knowledge and encourage teachers, students and healthcare providers to produce scientifically-based apps that help support safe and quality care, this study aimed to describe the development of an app called OMAC® for the evaluation of the level of consciousness in adults.

METHOD

This technological production study was performed according to the stages of the Contextualized Instructional Design and developed from May 2014 to April 2015, together with the Laboratory of Technological Production in Health and the Technologies and

Informatics in Health and Nursing Clinical Research Group of the Federal University of Santa Catarina (LAPETEC/GIATE/UFSC).

For the development of the technology, a team was formed consisting of a graphic designer, two programmers, a content specialist in the area of neurology and neurosurgery and a reviewer.

The app, Mobile Object for Consciousness Level Assessment (Objeto Móvel de Avaliação do Nível de Consciência - OMAC®), was developed from the Contextualized Instructional Design (CID) stages (Analysis, Design, Development and Evaluation). The CID is mainly based on immersive e-learning, with an emphasis on the configuration of customized environments, according to the units of study to be addressed, considering the individual learning needs of the target audience⁽¹¹⁾.

New technologies can become a learning tool since they are used in association with new teaching methodologies, capable of creating new dynamics of interaction, collaboration and knowledge construction. Accordingly, m-learning has been considered one of the most effective tools for improving active learning⁽¹²⁾.

In order to achieve the proposed aim, the theoretical framework of Problem-Based Learning (PBL) methodology was adopted to support the development of the app (Chart 1).

Chart 1 - stages of the PBL and the development of the OMAC®. Florianópolis, SC, Brazil, 2018

PBL steps	Development of the app
1- Identification of the problem	Bibliographic review - Importance of the evaluation of the level of consciousness
2- Exploration of previous knowledge	Bibliographic review - Identification of the learning needs
3- Creation of Hypotheses and possible mechanisms of action	Choice of the aspect of the level of consciousness assessment that will be considered. Follow a sequence or random choice
4- Identification of learning contents	Possibility of sending to the teacher the "steps" of the students during the use of the app
5- Individualized study	Availability of access at any time and place
6- Reassessment and application of new knowledge on the problem	Possibility of deploying responses and incentives while using the app
7- Evaluation and reflection of the reality	

Source: Adapted from Walsh⁽¹³⁾.

As an active teaching-learning methodology, in which learning occurs through action, through learning to do, the PBL predicts that the learning scenario should be chosen from a real context, which is part of the students' lives, so that the immediate identification of the problem can occur, motivating them to continue in the development of the investigative activity. The PBL allows the learner to acquire increasing degrees of autonomy, through the provision of an educational process centered on the person that learns, in a self-directed way, favoring the articulation between theory and practice⁽¹⁴⁾.

The study is part of the macro-project entitled mApp® - Open mobile platform for the development of m-Health systems in the innovation of human care, approved by the Ethics Committee for Research with Human Subjects, under authorization number 711.533.

RESULTS

Analysis Stage

In the first stage, the learning needs of undergraduate nursing students and the possible contributions to the solution of the problem were identified. From this, it was considered that an app, with good usability and based on the scientific literature, could facilitate learning about the evaluation of consciousness. Accordingly, an in-depth bibliographic search and the definition of the content to be included in the app were carried out.

In order to define the structure of the content, it was sought to establish meaningful, contextualized and guided learning for the use of ICTs and the development of problem solving skills and to conduct projects in the various learning segments of the student, applying PBL.

Design Stage

During this stage, the structure of the app interface, sequence of the content, definition of the topic and selection of the media were defined. The objective of the stage was to transform the content into didactic material, compatible with the app format, in an attractive and innovative way, using figures, videos and other resources.

Content elaboration occurred after a literature review on the evaluation of the level of consciousness in adults, which was structured in the app from the PBL stages. The contents represent the topics that make up the app structure, which can be accessed independently, according to the user's choice, without prerequisites (Figure 1).

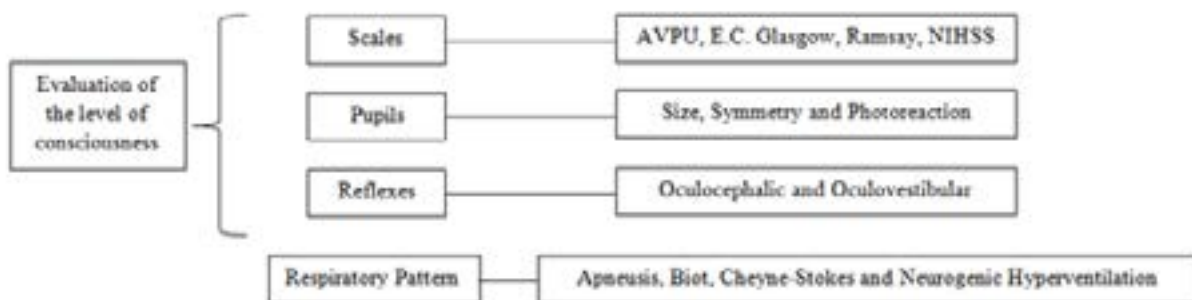


Figure 1 - OMAC® data structure. Florianópolis, SC, Brazil, 2018

From the initial app screen, it is possible to open each evaluation item with its respective subsequent information. On each screen, icons were made available demarcating options to be marked, as in the use of scales, in which it is possible to apply them and generate a score for the analysis of the clinical significance.

In the app, the scales of level of consciousness, pupillary evaluation, reflexes and respiratory pattern were used as the parameters for the evaluation of the level of consciousness according to the theoretical framework of the area, as shown in Figure 2⁽¹⁵⁻²⁰⁾.

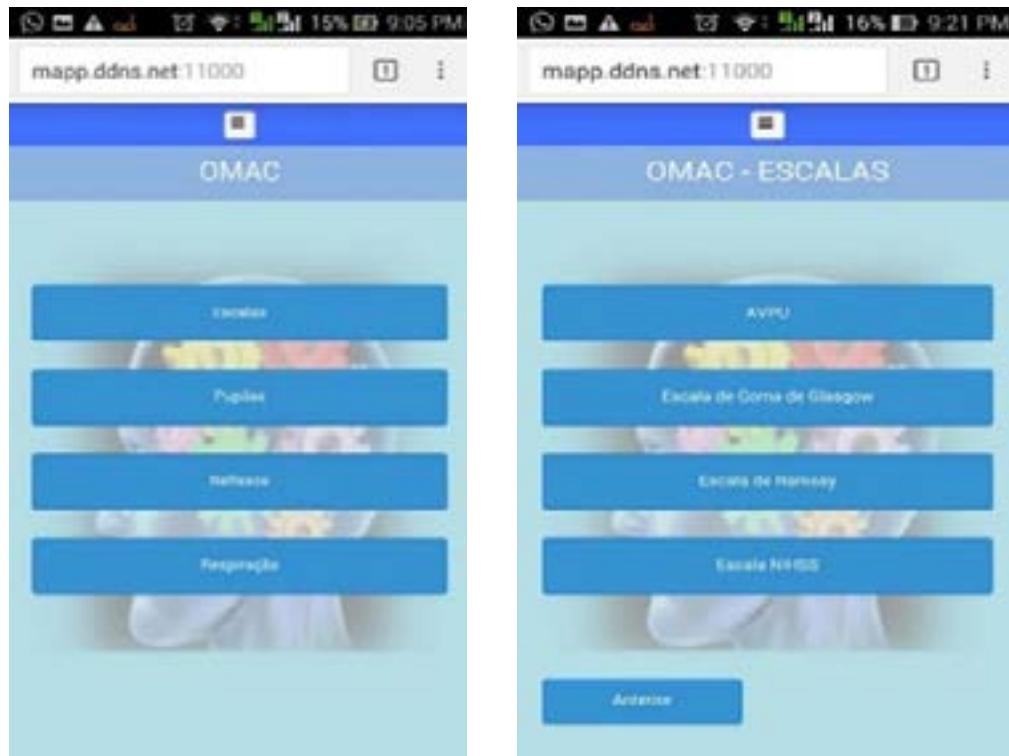


Figure 2 - Stages and scales of evaluation of the level of consciousness in the OMAC®. Florianópolis, SC, Brazil, 2018

The discussion and choice of graphic design occurred during this stage. It was chosen to use short texts with brief explanations, images and videos. The videos used are short and demonstrate situations that require the understanding of some items, such as decortication, decerebration, photomotor response of the pupil, oculocephalic and oculovestibular reflexes. For the demonstration of the respiratory patterns, animated graphics were used, which can help in locating the lesion that led to the altered level of consciousness (Figure 3).



Figure 3 - Hyperventilation pattern presented in the OMAC®. Florianópolis, SC, Brazil, 2018

Development Phase

In this stage, the production of the app on the m-App® platform took place, considering the assumptions of PBL methodology.

First, a storyboard was created to conduct the formulation of the sequence of the app content and its respective critical nodes before insertion into the m-App® development platform, developed by LAPETEC/GIATE/UFSC. The scales, pupils, reflexes and breathing were considered to be the critical learning nodes for the evaluation of the level of consciousness.

Next, the content was distributed on different screens, with the users being offered the options to return to the previous screen, continue or return to the main screen.

The app was written in simple, interpreted, object-based, and dynamic language, hence the choice of JavaScript (JS). The ExJS library, widely employed for web apps, was also used, due to the possibility of better use of the resources offered by the HTML5 standard, which serves the latest multimedia⁽²¹⁾.

The Cascading Style Sheets language CSS3 was used to define the styles and effects applied, while the app was structured in object format. The notation used for this object was JavaScript Object Notation, which is based on a subset of the JavaScript programming language and is a lightweight data exchange format that allows machines to easily interpret and generate data, and makes reading and writing easy for the users. The app runs on NodeJS, which allows multiple simultaneous connections on a single physical machine, i.e. multiple users can access the app without any unavailability of services⁽²²⁻²³⁾.

The Cordova Application Programming Interface, an app programming interface that allows the mobile app developer to access the native device function, such as the camera, GPS, and SMS⁽²⁴⁾, was used in order for the app to work on mobile phones.

Evaluation Step

In the final phase, the review of the content of the app by the researchers, the performance of tests for identification and correction of errors in the technological production occurred, followed by the conference of the graphic project, in order to reduce the possibility of failures.

The app was submitted to evaluation by teachers specializing in the care of critically ill patients and also by undergraduate Nursing students, performing a pre and post-test, obtaining significant results that will be disclosed in future studies.

DISCUSSION

The creation of innovative healthcare technologies is highlighted on the world stage, promoting quality of care, directed toward clinical reasoning, evidence-based behavior, rapid and effective information, and patient safety.

At present, there is a great increase in the use of apps by students and professionals, and the uses of these mobile technologies favor nursing at the bedside, communication and interaction with the patient, as well as clinical and educational skills in health. Despite advances, it is imperative to continuously evaluate these technological resources so that the functionalities are relevant and provide up to date knowledge⁽²⁵⁾.

The practice of assessing the level of consciousness is fundamental for monitoring, execution of interventions and decisions on nursing and medical diagnoses, being a daily practice in the care for critically ill patients. However, this evaluation is often made by

judgments that have imprecisely defined concepts and are therefore conditioned to a subjective evaluation. Delays in detecting signs of an altered level of consciousness may lead to misdiagnosis and have adverse consequences, such as premature termination of treatment and loss of the clinical opportunity for continued treatment⁽²⁰⁾.

In this context, the scales and other requirements of the neurological examination, used in assessing the level of consciousness of critically ill patients, represent important progress in guaranteeing adequate care and therapy for each case. For this, the existence of instruments of easy application, capable of facilitating the rapid identification of dysfunctions or changes in the neurological parameters, is necessary⁽¹⁰⁾.

The most widely used scales and, therefore, chosen for inclusion in the app were the AVPU - Alert, Verbal stimuli response, Painful stimuli response, or Unresponsive, recommended by the National Association of Emergency Medical Technicians and the American College of Surgeons Committee on Trauma (ACS/COT). The scale can be used to make a rapid assessment of the consciousness⁽¹⁸⁾.

In the case of sedation, the main indication is the use of the Ramsay scale, which is based on six stages, the three lower ones referring to conscious patients, while the maximum values refer to those sedated. It is considered quick to apply and easy to interpret⁽²⁶⁾.

Another scale adopted was the National Institute of Health Stroke Scale, since cerebrovascular diseases can lead to important changes in the level of consciousness. The scale is simple, safe and is based on 11 items of the neurological exam⁽¹⁹⁾.

The Glasgow coma scale is internationally recognized for the assessment of the level of consciousness of patients in intensive care. The parameters of this tool contribute to the execution of adequate clinical practice and interventions. However, studies reveal that, in spite of the significant relevance of this scale, in some scenarios there is a divergence in the results of the scores, and consequently, in the clinical evaluation. Therefore, having an easily accessible technology, with updated information, promotes an effective and concordant evaluation⁽²⁰⁾.

In a new update, a new clinical evaluation was defined in the Glasgow Coma Scale, being analyzed through the item denominated "eyes", which is the ability to open the eyes due to sound, pressure or the inability to open the eyes. In the "verbal" item the variables allow the professional to analyze whether the speech is oriented, confused, emanates only words, sounds, or no sound emitted. The motor evaluation evaluates whether the individual obeys commands, localizes, presents normal and abnormal flexion, extension or the inability to move⁽²⁷⁾.

One of the components of the physical examination performed by the nurse is the pupillary evaluation, in which it is possible to identify possible structural damage in the central nervous system, such as an increase in intracranial pressure, thus favoring immediate interventions to avoid harm. The pupillary evaluation is composed of the analysis of pupil size (miotic, mydriatic, normal), symmetry (isochoric, anisocortical) and the photomotor response⁽²⁷⁾.

Despite the proven importance of the evaluation, an international study found that critical and neurosurgical nurses underestimate and incorrectly evaluate pupil reactivity, thus emphasizing the importance of evaluation tools to increase the accuracy and consistency of the evaluation for the early detection of neurological problems⁽²⁸⁾.

Reflexes are involuntary responses to a stimulus, involving a receptor, the afferent or sensitive pathway carrying the stimulus to the CNS, the presence of neurons between the afferent and efferent pathways and an effector organ. This mechanism constitutes the functioning of the oculocephalic reflex and allows the observation of the directional movement of the eyes in response to movements made by the head. The occurrence of this stimulus involves the vestibular nerve, specifically the VIII of the cranial nerve and receptor of the cervical musculature. The nerves involved in the ocular responses are the

abducens nerve (VI), oculomotor nerve (III) and trochlear nerve (IV)⁽²⁹⁾.

The oculovestibular reflex allows the evaluation of the absence or presence of ocular movements, with the participation of the vestibular nerve in the afferent pathway, and the abducens VI and oculomotor III in the efferent pathways⁽²⁹⁾.

The reflex evaluations are a fundamental practice for the detection of brain death, directing the appropriate procedures for the maintenance of organs and tissues, whether in the case of a potential donor, or the end of the treatment. In addition, the preparation and responsabilization of professionals regarding care in the body systems is fundamental⁽⁹⁻¹⁰⁾.

The CNS is responsible for the respiratory mechanism, specifically in the cerebral cortex, which receives constant information on the concentration of gases and the chemical composition of the blood provided by specialized receptors called chemoreceptors. However, the occurrence of brain injuries may compromise the respiratory systematics, making the perfusion of cellular and tissue oxygen inadequate⁽³⁰⁾.

With the respiratory patterns presented by the patient, it is possible to identify the location of the lesion at the neurological level, for example: Cheyne-Stokes, associated with lesions in the diencephalon and basal ganglia; neurogenic hyperventilation, compromising the midbrain; apneusis, lesions in the pons and Biot's respiration, alterations found in the olfactory bulb. With these findings, the evaluation of the nurse becomes fundamental for the detection of respiratory abnormalities and subsequent intervention⁽³⁰⁾.

The need to publish the evaluation of the technology is highlighted as a limitation. This should be carried out by teachers and students, so that it is possible to use it widely in educational and care practice. In addition, the content of the Glasgow Coma Scale needs to be updated.

CONCLUSION

In this study, which reports on the production of the OMAC® app, from the relevance of the theme, the analysis stage identified the needs and critical nodes of the learning to assess the level of consciousness, followed by the design, development and evaluation stages of the app produced.

The app is innovative in its ability to be accessed from different mobile devices and platforms, provide learning opportunities without pressure due to time or place, and without the user having to move away from the patient to obtain safe information, review a practice or apply a scale. In addition, it was sought to encourage students to use the app as part of the process of nursing care for the critically ill patient with altered level of consciousness.

It should be highlighted that apps produced by professionals bringing together scientific evidence, experience and knowledge of the context, having the potential to integrate into the practice in such a way that the tool can become a care procedure. However, users of this technology should be aware of contamination issues, with the sanitation of the device before and after use being essential.

At this time, it is necessary to insert the RASS (Richmond Agitation-Sedation Scale) as it is more detailed and to update the Glasgow coma scale considering the changes that occurred in 2018. In the future, after registration of the software, the app will be made available in app stores, allowing broad access for education and care institutions.

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Received: 04/07/2018

Finalized: 04/02/2019

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Final approval of the version to be published - WCTSB, GTMDS, AGA, SFR, SRM

Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - WCTSB, GTMDS, AGA, SFR, SRM
