DEVELOPMENT AND ASSESSMENT OF A VIRTUAL LEARNING ENVIRONMENT FOR TRAINING IN MALIGNANT HYPERTHERMIA

Desenvolvimento e avaliação de ambiente virtual de aprendizagem para capacitação em hipertermia maligna

Desarrollo y evaluación del entorno virtual de aprendizaje para capacitación en la hipertermia maligna

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ABSTRACT: **Objective:** To develop and assess the performance of a virtual learning environment (VLE) called "Tele-education in Malignant Hyperthermia" to promote health education for surgery nursing teams. **Method:** This is a technology validation study of methodological development research with quantitative and qualitative approach. It revealed the process of creation and assessment of an educational multimedia program as a VLE website for nursing professionals of surgery centers and for experts in health informatics. **Results:** The experts' assessment showed great acceptability of the program and received a classification of "very good" in most of the assessed items. **Conclusion:** The developed virtual learning environment is an effective tool to support teaching on malignant hyperthermia for nursing teams of surgery centers.

Keywords: Malignant hyperthermia. Surgicenters. Perioperative nursing. Health education. Nursing informatics.

RESUMO: **Objetivo:** Desenvolver e avaliar a execução de um ambiente virtual de aprendizagem (AVA) intitulado "Teleducação em Hipertermia Maligna", visando a promover educação em saúde para equipes de enfermagem em centro cirúrgico. **Método:** Estudo de validação de tecnologia do tipo pesquisa de desenvolvimento metodológico com abordagem quanti-qualitativa, revelando o processo de criação e avaliação de um programa multimídia educacional no formato *website* como AVA para profissionais de enfermagem em centro cirúrgico e especialistas em informática em saúde. **Resultados:** A avaliação dos especialistas mostrou grande aceitabilidade do programa, recebendo classificação de "muito bom" para a maioria dos itens avaliados. **Conclusão:** O ambiente virtual de aprendizagem desenvolvido mostrou-se uma ferramenta eficaz para apoiar o ensino sobre hipertermia maligna a equipes de enfermagem em centro cirúrgico.

Palavras-chave: Hipertermia maligna. Centros cirúrgicos. Enfermagem perioperatória. Educação em saúde. Informática em enfermagem.

RESUMEN: **Objetivo:** Desarrollar y evaluar la ejecución de un entorno virtual de aprendizaje (EVA) llamado "Teleeducación en Hipertermia Maligna", con el propósito de promover la educación en salud para equipos de enfermería en centros quirúrgicos. **Método:** Estudio de validación de la tecnología de la pesquisa del desarrollo metodológico, con abordaje cuantitativo y cualitativo, que reveló un proceso de creación y evaluación de un programa de multimedia educacional en formato de sitio electrónico como EVA para profesionales de enfermería en centros quirúrgicos y expertos en informática aplicada a la salud. **Resultados:** La evaluación de los expertos mostró una gran aceptabilidad del programa con el recibimiento de la clasificación "muy bueno" para la mayoría de los ítems evaluados. **Conclusión:** El entorno virtual de aprendizaje desarrollado se mostró una herramienta eficaz para apoyar la enseñanza de la hipertermia maligna a los equipos de enfermería en centros quirúrgicos.

Palabras clave: Hipertermia maligna. Centros quirúrgicos. Enfermería perioperatoria. Educación en salud. Informática aplicada a la enfermería.

INTRODUCTION

The current high-level connectivity is a gift given by the internet. It may promote information sharing, improvement of didactic maneuvers, and development of health studies not only in education, but in all areas of knowledge[1].

The learning-teaching process does not currently focus only on one physical and traditional environment, it is interposed between informatics and technologies. It is not different in health. Tele-education, for instance, works as an important resource for the education of health professionals, not only for practical activities, but also for knowledge transmission and research[2,3].

Society is changing, and so is nursing. Every day, nursing teams are challenged to present new knowledge and competences that respond to such changes. Therefore, the internet, together with tele-education, works as a source of information that enables developing new knowledge, achieving new skills, training professionals, and facing challenges that are determined by technological advances[4,5].

The virtual learning environment (VLE) aims to support technology-related activities. It enables adapting and adding different kinds of media with distinct purposes, besides providing teaching-learning news[2,5,6]. For instance, in surgicenter nursing, several subjects may serve as an object of training according to specific needs or service updating, such as malignant hyperthermia (MH), which is a rare dominant autosomal genetic disorder of the skeletal muscle that is potentially fatal and related to an uncontrolled release of calcium from the sarcoplasmic reticulum[7].

MH is traditionally characterized by an abnormal hypermetabolic reaction to anesthetic inhalator agents of the halogenate group, to depolarizing neuromuscular blocking agents (such as succinylcholine) or, even more rarely, to stress (like extreme physical exercises in warm environments)[7-9].

In Brazil, the first report on this syndrome was published in 1975 and there are no current data about it, but estimates show an occurrence from 500 to 1,000 MH cases per year only in the state of São Paulo[9,10]. The number of deaths due to MH is high not only due to the syndrome complexity, but also because of the lack of knowledge by the professionals. The mortality index per MH decreased from 80%, in 1970, to 5% in 2007. The treatment of disease reactions should

result in 100% survival, but we need quick and qualified care to achieve it, which can only happen with proper training of the surgical center professionals[10].

Based on the relevance and severity of MH, we noticed the need for training teams in surgical centers so that they can provide early diagnosis and deal with MH crisis. Therefore, we considered the following question: can the VLE provide a conceptual and technological contribution to nursing education?

OBJECTIVE

This study aimed to develop and assess the performance of a virtual learning environment (VLE) named "Tele-education in Malignant Hyperthermia", with the objective of promoting health education for nursing teams in surgery centers.

METHOD

This is a technology validation study of methodological development research with quantitative and qualitative approach. This paper reports the elaboration and reveals the result of the assessment process provided by surgical center nursing professionals and health informatics experts about an educational multimedia program in the website format as VLE.

The elaboration and development of a VLE comprise a group of activities that include structural organization of essential elements, such as the chance of reviewing and redoing them in undetermined moments[5].

We based our methodology on Struchiner[11] concepts, which establish basic principles for developing educational material and articulate the structural development stages in a proposal with different criteria[5].

The preceding variables that formed and defined the environment were: establishment of theme; choice of scenario to be composed; educational purposes; video and text formatting; and experts' assessment after using the VLE.

We divided the VLE production in two stages: the first one comprised theme definition and VLE creation; the second corresponded to environment assessment by a group of experts.

We established the MH as the theme to be discussed in the VLE. MH is also known as malignant hyperpyrexia and is a hypermetabolic syndrome of dominant autosomal character of chromosome 19. Considering it is a genetic disorder of the skeletal muscle, it involves decreasing the calcium reuptake and its uncontrolled release. MH occurs in patients who are prone to being exposed to agents that are used to induce general anesthetics[12-15].

Clinical signs of this rare and possibly fatal syndrome include: unexplained tachyarrhythmia, tachypnea, hypercalcemia, respiratory and metabolic acidosis, rhabdomyolysis, and hyperthermia[12,13].

We also prepared the following educational purposes for the development of the first stage of the VLE: presentation of MH history, concept definition, demonstration of the disease epidemiological aspects, characterization of the syndrome physiopathology and genetics, identification of the disease diagnostic types, treatment specification, and establishment of current laws about such illness.

After defining the theme and choosing the content and educational purposes, we divided the subject into three videos:

- video 1: presentation of the MH history; definition of the syndrome concept; demonstration of its epidemiological aspects; and characterization of its physiopathology and genetics;
- video 2: identification of the MH diagnostic types;
- video 3: specification of the MH treatment and establishment of current laws about the syndrome.

After we defined the themes to be discussed on the videos, we produced them through the website https://www.powtoon.com/. Then, we began the search for questions discussing the MH. We chose ten multiple-choice questions. Five of the prepared questions were used in the pre-test. We repeated these five questions and added another five questions in the post-test. The repeated questions aimed to be used as data of knowledge prior to the assessment.

After the creation of videos and questionnaires, they were posted in a Google form (https://www.google.com/forms/about/) together with the Free Informed Consent (TCLE), with a sociodemographic questionnaire and references for their production. These stages compose the course, which can only be taken if the website created is accessed.

We created this website through the Wix tool (available at: http://pt.wix.com/). The website uses the "hyperlink" concept; therefore, it provides access to different pages and their respective content. The site provides information of the course, the team, how to participate, and general access. The website availability was performed only for evaluation purposes. The website can be accessed through the computer or using a mobile.

The second stage was the VLE assessment by a group of experts. Six experts would be sufficient for this kind of opinion, but we chose to increase this number to nine experts[16]. The sociodemographic characteristics of the evaluators include 29-50 years of age, all the experts had studied nursing and have worked in the area, and have worked in surgery centers and/or with health informatics. The evaluators include six professionals with Master's degree and two with PhD degrees.

The experts evaluated the VLE regarding the following items: content, educational purposes, learning assessment (pre- and post-test), interface, functionality, efficiency, accessibility, and navigability of the environment. The instrument used for the VLE assessment was outlined in a five-point Likert scale, in which:

1. represents very good;
2. good;
3. regular;
4. poor; and
5. very poor.

The research ethical aspects follow Resolution n. 466/12 from the Brazilian Health Council. The Research Ethics Committee from *Universidade de Pernambuco* approved the research under legal opinion n. 58350616.8.0000.5207, and all the evaluators agreed with the terms to take part in this paper by signing the TCLE.

RESULTS

The VLE with the Tele-education in MH course is available at http://modestobrenna.wixsite.com/cursohm. The opening page (Figure 1) presenting the environment has a title and a main menu. The environment is comprised of eight pages (HTML language), in which: one provides the main menu; four have information about the course (how to participate, contact, team); and three provide the course and the questionnaire for the VLE assessment.

The option "Begin" [*Início*] in the main menu contains a welcoming message to users, a link to begin the course and another link to get to know the team.

The tab "About the course" [*Sobre o Curso*] shows the course stages and how each one works. In addition, it also provides information such as methodology, study place, population, eligibility criteria, and research purposes.

The link "How to Participate" [*Como Participar*] provides a step-by-step on how to first access the entire course and then access the "Course" [*Curso*] link. It has two options: "Evaluator" [*Avaliador*] and "Participant" [*Participante*]. To take the course, the user must choose the option

"Participant" [*Participante*] and complete all the steps, as described in Figure 2.

With the aim of validating the interactivity, we asked for a feedback from professionals invited to assess the VLE. After taking the activities in the "Participant" [*Participante*] link, they needed to go to the "Evaluator" [*Avaliador*] link, where they would find a questionnaire about the VLE functioning and the provided educational purposes. The assessment page also provides a blank

Figure 1. First page of the website that shows the course "Tele-education in Malignant Hyperthermia". Recife, Pernambuco, Brazil, 2016.

space where experts may leave suggestions and comments for improvements.

In general, the website "Tele-education in Malignant Hyperthermia" was very well accepted by the evaluators, who provided suggestions for improvement and comments, which were mostly positive about the performed work. The assessed items were scored according to the scale: very good (VG), good (G), regular (Re), poor (P), and very poor (VP).

The first three questions of the assessment were about the way content is transmitted. These questions approach: didactics, clarity and objectivity; amount and quality; consistence and pertinence of the presented material.

Table 1 presents the distribution of answers obtained in the assessment made by experts on the content. The content was considered "good" by most of the experts (five) in "didactics, clarity, and objectivity". "Quantity and quality" of the content and "consistence and pertinence" received "very good" in most of the answers (five).

Questions four and five of the assessment form discussed about the course objective regarding the established educational purposes and the pertinence of the proposed learning assessment (pre- and post-test).

We observed, in Table 2, that most of the evaluations (five) considered the course objective regarding the proposed educational purposes in the VLE as "very good". Regarding the "learning assessment (pre- and post-test)" and its pertinence to the VLE content, most of the evaluations were positive, considering the item as "very good" (seven). Also regarding the pre- and

Table 1. Assessment of the VLE program made by experts regarding its content. Recife, PE, 2016.

	VG	G	Re	P	VP
Didactics, clarity, and objectivity	4	5	0	0	0
Quantity and quality	5	4	0	0	0
Consistence and pertinence	5	4	0	0	0

VG: very good; G: good; Re: regular; P: poor; VP: very poor.

Table 2. Assessment of the virtual learning environment program by experts regarding the educational purposes and questionnaires. Recife, Pernambuco, 2016.

	VG	G	Re	P	VP
Educational purposes	5	4	0	0	0
Learning assessment (pre- and post-test)	7	1	1	0	0

VG: very good; G: good; Re: regular; P: poor; VP: very poor.

Participant's Area:

TCLE

Registration form
• Sociodemographic questions

Pre-test
• Early knowledge of MH

Educational intervention
• Video 1
  • Education purposes: history presentation; definition of concept; demonstration of the epidemiological aspects; characterization of the MH physiopathology and genetics.
• Video 2
  • Educational purposes: To identify the MH diagnostic types.
• Video 3
  • Educational purposes: To specify the treatment and relate the current laws on MH.

References

Post-test
• Form to complete the educational intervention in MH and certification achievement.

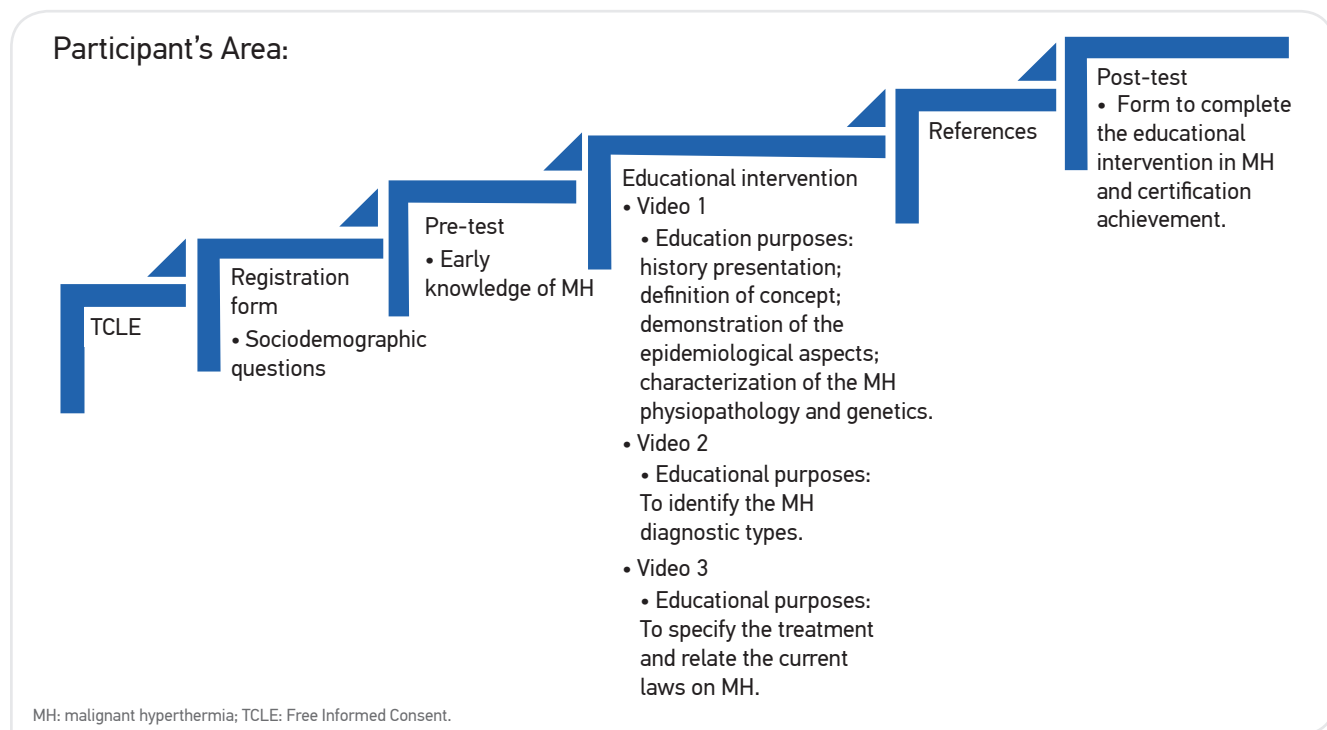MH: malignant hypermia; TCLE: Free Informed Consent.

Figure 2. Structure of the course in the VLE on "Tele-education in Malignant Hyperthermia". Recife, PE, Brazil, 2016.

post-test, one of the experts classified their pertinence as "regular"; he commented that the questions could be numbered and that some questions needed to be written more clearly.

The last four questions of the assessment form discussed the interface (colors, letters, figures and animations) of the VLE; functionality; effectiveness; accessibility and navigability of the website.

An analysis of the answers presented in Table 3 regarding the VLE interface shows that most experts (six) classified it as "very good". We also observed in the same question that one of the evaluators considered it "regular", but he did not make comments or suggestions to improve such topic. Most of the experts considered the "functionality" and "effectiveness" topics as "very good" (five). The item "accessibility and navigability" of the VLE received a "very poor" (one) evaluation from one of the experts, who did not make any comments or suggestions on the topic.

DISCUSSION

The VLE focuses on the technological mediation to support learning. It is part of the cyberspace, and one of its characteristics is to promote learning through the student-content-teacher interaction. An effective and qualified VLE production is achieved by observing the aspects: target audience, clarity, objectivity, accessibility, interface design, activities, and the content information is based on the learning-teaching process[17,18].

Technology is part of the daily routine of a large part of the population. There are several online health courses and trainings that are very easy to be accessed, which discuss about subjects such as pediatric nursing and pressure wound dressings. Hence, considering the nurse as part of the population with regular access to the internet, and nursing being an essential part of the surgery center team, the skills necessary for these professionals may and should also be done *online*[1,2].

Table 3. Assessment by experts regarding the interface, functionality, effectiveness, accessibility, and navigability of the virtual learning environment program. Recife, Pernambuco, 2016.

	VG	G	Re	P	VP
Interface	6	2	1	0	0
Functionality	5	4	0	0	0
Effectiveness	5	4	0	0	0
Accessibility and navigability	4	4	0	0	1

VG: very good; G: good; Re: regular; P: poor; VP: very poor.

Therefore, MH should not be treated differently, considering it is a very important syndrome with high mortality rates; and the nurse, together with the anesthesiologist, is part of the quick response team (TRR) for treating the crisis when the patient is affected by the disease[19].

The MH knowledge of nurses, whether of clinical signs or administration of medication to treat the syndrome, increases the patient's chances of survival, because the quickness in diagnosis is directly proportional to the chances of the patient receiving treatment intervention[10,19].

By integrating knowledge, resources, technologies and information, the VLE content should reveal the essential, in small portions, so that we can achieve the proposed purposes earlier. For the proper functioning of the VLE, we need to distribute its information in accessible contents by building a learning path that allows the participant to develop the skill of coordinating his/her knowledge construction[17,18].

When we consider the target audience and their skills, we should organize learning situations, plan and propose activities, provide relevant information, encourage the search for different sources of information, cause the reflection upon the processes and products, and favor the formation of concepts. In the studied VLE, the programmatic content was delivered in form of videos with the aim of reaching the pre-established educational purposes, which received a positive assessment by experts[6,18].

The learning assessment should not be understood as a practice to quantify what is learnt; it should be a continuous research process aiming at interpreting and following the knowledge acquired by participants. When the learning assessment is also performed in the digital environment, there might be a combination of several media, which therefore make the proposed activities dynamic[5,17].

Regarding the technical aspects, the interface design and the VLE functionality should be pleasant and aesthetically attractive to guide the participant and get his/her attention to learning contents. Regarding the VLE effectiveness, the participant has to be able to pass through all the content without needing to visit numberless screens several times before reaching his/her intended destination; therefore, we need a clear indication of the links in the web page[2,17].

Regarding accessibility and navigability, we need a guarantee of easy access to the VLE through any computer or mobile device connected to the internet. The platform should also be settled to provide free access of the participants during the activities[2,17].

Evaluations, comments and suggestions stimulated the manifestation of experts' opinions and enabled to visualize

the established educational purposes with more foundation and fidelity[2].

This study limitations include a privileged look on data collection, considering that the experts come from the discussed theme area; in addition, the results obtained in similar studies not always can be generalized by their own nature and by the used method. But as any other research, we do not intend to conclude the subject, we want to open new perspectives for future studies.

CONCLUSION

According to the evaluation of experts in surgery center and health informatics, the VLE "Tele-education in Malignant Hyperthermia" was an effective tool during the learning process. It is believed that promoting the VLE as an educational tool might contribute to achieve an integration between teaching, researching and assisting as a strategic resource to train nurses[2,17].

After the analysis of the assessments made with this program, we could prove a contribution regarding the initial development proposal of an assisted learning program for nursing. The assessments also provided warning for the modification of some of the website aspects and valuable contents for future availability of the VLE.

Informatics should be considered as an instrument that can be used for education, providing more flexibility of information presentation. In nursing, informatics does not only mean the use of computers, it is a medium to improve the teaching practice and profession assistance[4,20].

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