The contributions of digital technologies in the teaching of nursing skills: an integrative review

Contribuições das tecnologias educacionais digitais no ensino de habilidades de enfermagem: revisão integrativa

Contribuciones de tecnología educativa digital en la educación de habilidades de enfermería: revisión integradora

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ABSTRACT

Objective: To analyze the contributions of digital educational technologies used in teaching nursing skills.
Method: Integrative literature review, search in five databases, from 2006 to 2015 combining the descriptors 'education, nursing', 'educational technology', 'computer-assisted instruction' or related terms in English.
Results: Sample of 30 articles grouped in the thematic categories 'technology in the simulation with manikin', 'incentive to learning' and 'teaching of nursing skills'. It was identified different formats of digital educational technologies used in teaching Nursing skills such as videos, learning management system, applications, hypertext, games, virtual reality simulators.
Conclusions: These digital materials collaborated in the acquisition of theoretical references that subsidize the practices, enhancing the teaching and enable the use of active learning methods, breaking with the traditional teaching of demonstrating and repeating procedures.
Keywords: Education, Nursing. Educational technology. Computer-assisted instruction.

RESUMO

Objetivo: Analisar as contribuições da utilização de tecnologias educacionais digitais no ensino de habilidades de enfermagem.
Método: Revisão integrativa da literatura, com busca em cinco bases de dados no período de 2006 a 2015 com combinações dos descritores "educação em enfermagem", "instrução por computador", "tecnologia educacional" ou respectivos termos em inglês.
Resultados: Amostra de 30 artigos agrupados nas categorias temáticas "tecnologia na simulação com manequins", "estímulo à aprendizagem" e "ensino de habilidades de enfermagem". Identificou-se diferentes formatos de tecnologias educacionais digitais utilizadas no ensino de habilidades de Enfermagem, como vídeos, ambientes virtuais, aplicativos, hipertexto, jogos e simuladores com realidade virtual.
Conclusões: Esses materiais digitais colaboraram na aquisição de referencial teórico que subsidiam as práticas, dinamizam o ensino e possibilitam a utilização de métodos ativos de aprendizagem, rompendo com o ensino tradicional de demonstrar e repetir procedimentos.
Palavras-chave: Educação em enfermagem. Tecnologia educacional. Instrução por computador.

RESUMEN

Objetivo: Analizar las aportaciones de la utilización de tecnología educativa digital utilizadas en la enseñanza de habilidades de enfermería.
Método: Revisión integradora con la búsqueda bibliográfica en cinco bases de datos desde 2006 hasta 2015 con combinaciones de descriptores 'educación en enfermería', 'instrucción por computadora', 'tecnología educacional' o respectivos términos en inglés.
Resultados: Muestra de 30 artículos agrupados en categorías temáticas 'tecnología en maniquíes de simulación', 'estimulando el aprendizaje' y 'enseñanza de habilidades de enfermería'. Se identificaron diferentes formas de tecnologías educativas utilizadas en la enseñanza de habilidades de enfermería, tales como videos, entornos virtuales, aplicaciones de hipertexto, juegos, simuladores de realidad virtual.
Conclusiones: Estos materiales digitales ayudan en la adquisición de marco teórico que apoyan las prácticas, optimizan la enseñanza y permiten el uso de métodos de aprendizaje activo, rompiendo con la enseñanza tradicional para demostrar y repetir los procedimientos.
Palabras clave: Educación en enfermería. Tecnología educacional. Instrucción por computadora.

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INTRODUCTION

Many educators and teaching institutions consider informatics resources as a possibility for teaching modernization, naming them "new technologies"[1]. However, it must be remembered that the mere use of technology is not a guarantee of a better learning experience. It is also necessary to develop pedagogical actions that allow for a critical connection to reality, built on autonomy and on the cooperation of students[2].

Therefore, digital educational technologies (DET) are increasingly used in health courses, cooperating to the diversification and flexibility of activities, and allowing for a student to get access to content in real time and wherever they want, in addition to providing opportunities for the interaction among students outside of the physical space of the classroom[3]. These resources include videos, games and hypertexts, used in face-to-face activities or from a distance (*e-learning)*, which can be broadcast on the internet, through DVDs, CD-ROMs, television or mobile phones *(m-learning)*[4-6].

These multiple possibilities of technological resources targeted at undergraduate health students can be proposed and guided by many different educational paradigms, as evidenced in the systematic review published by the Pan American Health Organization[7]. The teaching strategies that use DET were positively evaluated by the students, and considered a resource that makes activities more dynamic, and replaces the repetition and the passivity of face-to-face classes. The results of this systematic review pointed out the necessity to conduct broader studies, evaluating the possibilities of incorporating new technological resources to teaching[7].

Considering this, it can be noted that the DET are increasingly present in nursing teaching, be it inside the classrooms or in practice labs, introducing the concept of online simulations (*e-simulation*)[1]. A great number of technological innovations cooperate for the development of clinical nursing abilities, such as simulation, virtual learning environments and other digital didactic materials[8]. In the literature, there are reports that these technological resources dynamize teaching, and develop abilities and knowledges capable of mobilizing problem-solving actions[2].

Nursing abilities can be conceptualized as activities that are peculiar to the exercise of the profession, related to the conduction of interventions whose objective is recovering and preserving human health. Among them are those related to daily activities such as corporal hygiene, sleep, rest, eating, hydrating and evacuating, as well as those related to therapeutic actions, such as the administration of medication, catheterizations, hand hygiene, vital signs checking, among others[9].

The teaching of skills in the fields needs to be constantly improved, due to the complexity of the caring process, and should be based on evidences and integrate theoretical knowledge with practical actions. Curricular activities also cannot ignore the safety of the patients in the environment where they are offered care, nor that of the students during practice[10]. Therefore, the educational technologies are incorporated in Nursing teaching to collaborate in the development of the culture of safety for the patient[8]. If there is a chance for the student or the professional to simulate the execution of care in a virtual environment or in manikins, as many times as they need, it can help them to achieve and perfect their abilities.

Considering that the DET are increasingly present in the teaching of Nursing, and that there are many different materials that can be used with that purpose, the question became what are the benefits of using these technological resources to learn Nursing skills. The review of articles that analyzed these resources is relevant for the implementation of activities which can teach abilities that demonstrate to be effective in the teaching of Nursing, thus contributing to health education.

The objective of this study was to analyze the contributions of the use of digital educational technology in the teaching of Nursing skills.

METHODOLOGY

This is an integrative review of the literature that followed five steps: formulation of the problem, data collection, data evaluation, data analysis and interpretation, and results presentation[11]. In the formulation of the problem, the strategy PICO[12] was adapted, and the following guiding question was presented: what are the contributions of the use of digital educational technologies in the teaching of Nursing skills.

Data collection was conducted in the following databases: *Literatura Latino-Americana do Caribe em Ciências da Saúde* (LILACS), MEDLINE/PubMed, Scopus, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and *Web of Science* (WOS).

The descriptors adopted for the research were extracted from the Bank of Descriptors of Health Sciences (DeCS) and the Medical Subject Headings (MeSH), and were: *"Educação em Enfermagem*/Education, Nursing"; "*Tecnologia Educacional*/Educational Technology" and "*Instrução por Computador*/Computer-Assisted Instruction". The cross

Database	Crossing
LILACS	*Educação em Enfermagem AND Instrução por Computador*
	Educação em Enfermagem AND Tecnologia Educacional
CINAHL	Education, Nursing AND Computer-Assisted Instruction
	Education, Nursing AND Educational Technology
MEDLINE/PubMed	Education, Nursing AND Computer-Assisted Instruction
	Education, Nursing AND Educational Technology
Scopus	Education, Nursing AND Computer-Assisted Instruction
	Education, Nursing AND Educational Technology
Web of Science	Education, Nursing AND Computer-Assisted Instruction
	Education, Nursing AND Educational Technology

Chart 1 – Crossing the DeCS and the MeSH per Database. Porto Alegre, 2016

Source: Authors.

between the DeCS and the MeSH followed the protocol presented in Chart 1.

Inclusion criteria included only articles obtained in researches with primary data which discussed the theme in the languages Portuguese, English and Spanish, fully available online, and published from 2006 to 2015. This period of bibliographic research was chosen considering the possibility of identifying digital resources that were still available for use. The exclusion criteria included abstracts from works published in the annals of events, dissertations, thesis or texts from government Institutions; studies with secondary data, such as reviews, reports or reflections were also excluded.

To evaluate the information, an instrument was chosen that contained the basic data of the articles selected, including title, year, year of publishing, objectives, methodology, results and conclusion. From the information provided by the data collection instrument, a synoptic table was elaborated to present the results, including the following aspects: contribution for the teaching of Nursing abilities, authors, type of DET and subject developed. It should also be highlighted that ethical aspects were observed in this revision article, quoting the authors and indicating the source in the paraphrases.

RESULTS

The cross between the DeCS and the MeSH identified a total of 6,917 articles in the databases, 164 in the LILACS, 926 in the CINAHL, 3,613 in the MEDLINE/PubMed, 20,098 in the Scopus and 116 in Web Science. 4,493 records were excluded for being duplicates, or for not refering to the theme of the study. The selected articles that fit the eligibility criteria were 76, and 46 articles that would not answer the guiding question were excluded. Therefore, 30 were selected for this integrative review (Figure 1).

From the 30 articles that composed the sample, 21 (70.0%) were in English and 9 (30.0%) in Portuguese. The periodical with the greatest number of publications is *Nurse Education Today*, with 9 (30.0%) articles. Regarding the year of publication, 2013 was the prevalent year, with a sample of 6 (20.0%) articles. Regarding the origin of the studies, it was noted that 11 (36.7%) were developed in Brazil.

After reading, analyzing and synthesizing the content of the articles, three thematic categories were identified, regarding the contributions of the use of DET in the teaching of Nursing abilities, which were: "Technology in the simulation with manikins", "Stimulation to learning" and "The teaching of Nursing abilities". Chart **2** presents the dis-tribution of the articles analyzed according to the thematic category, the DET used and the subject discussed regard-ing teaching.

DISCUSSION

The articles in this review show the contribution of different technologies for the teaching of Nursing skills. In face of the great amount of technologies, it was found that the terminology DET can refer to a high-fidelity simulation manikin[13], a virtual environment simulator[15], videos[23], educational games[29], mobile apps[22], hypertext[28], as well as complete courses with more than one agregate digital resource[18]. There is an expressive technological production in the health field, and Nurses are

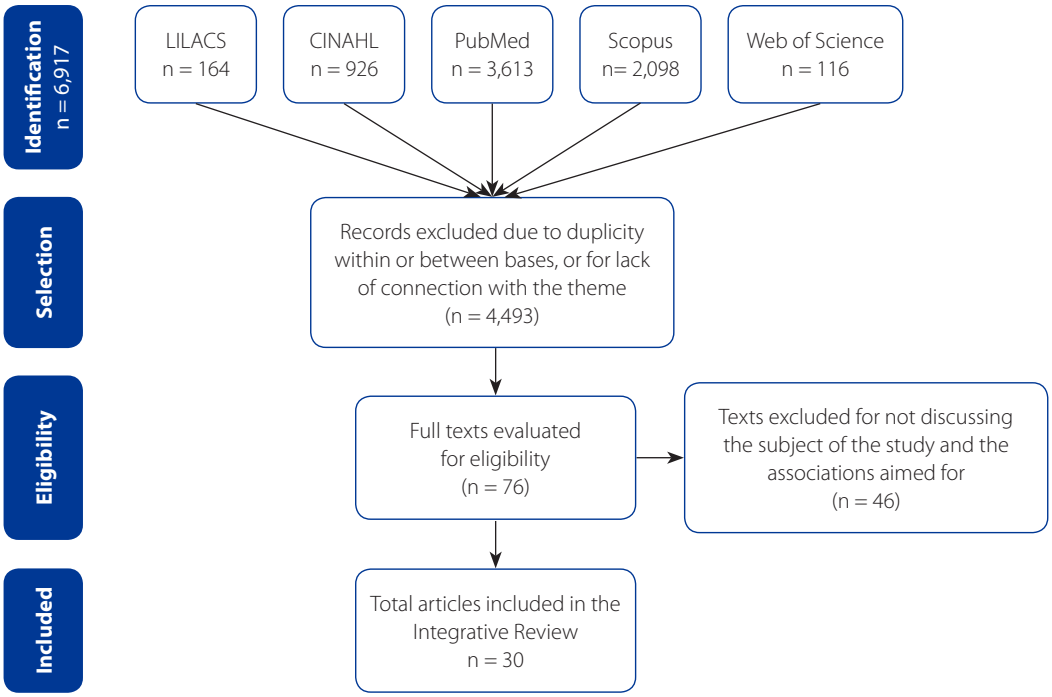

Figure 1 – Diagram of the selection of articles for the integrative review. Porto Alegre, 2017

Source: Authors.

a part of the multiprofessional team responsible to develop these resources.

These digital materials were produced to be used in different contexts, such as face-to-face teaching[29], online courses[39] or specifically destined to mobile phones[22]. The classroom, in this context, transcends the face-to-face physical environment. Since most of these resources were generated for students and undergraduates, which are mostly young, their accessibility in mobile devices respects the characteristics of these connected users, who can access the education objects in the time and place required.

In the analysis of the articles, three thematic categories were found, and are here presented. The subject "Technology in the simulation with manikins"[13-16] was characterized by studies that presented an integration of the use of software in the simulation settings, offering greater precision and realism. The practices that associate these two tools aided the students in their comprehension of the anatomy involved in the procedure, and made it easier for them to learn the necessary manual skills[14]. Likewise, the possibility of repeating the skill many times in simulators gives confidence to the student, and according to them, collaborates for the safety of the patient, diminishing their chance to cause any damage[16].

An evaluation of the performance of learners have shown that, through the use of a peripheral venous puncture using manikin simulation, virtual reality, and the association of both resources, the association of these two technologies ensured a better performance[15]. In another study, that also combined the use of virtual simulation software with simulation manikins, the development of cognitive and motor skills had better results regarding the traditional methods of teaching abilities[13]. The association of different technological resources develops many different abilities, promoting a meaningful learning experience.

The thematic category "Learning stimulus" united the articles that related the incorporation of DET in active learning methods, allowing for the protagonism of the student[17-30]. The educational software for the teaching of nursing skills stimulates the independence of the students, contributing to the association of theory and practice, as well as recovering subjects, such as anatomy and physiology, that had been studied in previous semesters[17].

The subjects that develop abilities have face-to-face classes but, by using a virtual learning environment (VLE), they promote a better utilization of the theoretical content, making the experience more dynamic inside the classroom and boosting the interest of the students in their own learning experience[27]. In a Brazilian study, that used VLE with problem-based learning about vital signs, the experience was mentioned by the participants as new and interesting, as it stimulated discussions and the curiosity of the students in seeking new alternatives[25].

Thematic category	Authors	Type of DET	Subject
Manikin simulation technology	Chen; Grierson; Norman, 2015[13]	High fidelity simulator in manikins and low fidelity simulators in software.	Evaluation skills
	Johannesson; Silén; Kvist; Hult, 2013[14]	Multimedia software Simulator	Male vesical catheterization
	Jung; Park; Lee; Jo; Lim; Park, 2012[15]	Virtual reality with the *haptics* device	Venous puncture
	Jöud; Sandholm; Alseby; Petersson; Nilsson, 2010[16]	Multimedia software Simulator	Male vesical catheterization
Learning stimulus	Góes; Fonseca; Camargo; Oliveira; Felipe, 2015[17]	Educational software	Vital signs
	Mettiäinen; Luojus; Salminen; Koivula, 2014[18]	Online course with texts and multimedia tools	Drug administration
	Sowan; Idhail, 2014[19]	Online course with videos	Drug administration
	Bloomfield; Jones, 2013[20]	Explanatory narratives, videos, photographs, online periodicals and quiz	Nursing skills in general
	Frota; Barros; Araújo; Caldini; Nascimento; Caetano, 2013[21]	Virtual learning environment	Venous puncture
	Galvão, Püschel, 2012[22]	Mobile-platform multimedia application	Measurement of central venous pressure
	Holland; Smith; McCrossan; Adamson; Watt; Penny, 2013[23]	Video	Drug administration
	Lin, 2013[24]	Videos and material sharing through technology	Vesical catheterization
	Cogo; Silveira; Pedro; Tanaka; Catalan, 2010[25]	Virtual learning environment	Vital signs
	McMullan, Jones, Lea, 2011[26]	Interactive online activities	Drug calculation
	Tanaka; Catalan; Zemiack; Pedro; Cogo; Silveira, 2010[27]	Virtual learning environment	Vital signs
	Cogo; Pedro; Silveira; Silva; Alves; Catalan, 2007[28]	Hypertext, educational games and simulations	Nursing skills in general
	Silva; Cogo, 2007[29]	Hypertext with illustrative images and educational game	Venous puncture
	Tsai; Chai; Hsieh; Lin; Taur; Sung; Doong, 2008[30]	Virtual reality simulator	Fully implanted catheter injections
Teaching of nursing skills	Góes; Fonseca; Camargo; Hara; Gobbi; Stabile, 2015[31]	Virtual learning environment	Vital signs
	Sowan, 2014[32]	Videos	Drug administration
	Lopes; Ferreira; Fernandes; Morita; Poveda; Souza, 2011[33]	Educational software	Male and female vesical catheterization

Chart 2 – Synoptic table of the articles included in the sample. Porto Alegre, 2017 (continue)

Source: Authors.

Thematic category	Authors	Type of DET	Subject
Teaching of nursing skills	Cardoso; Moreli; Braga; Vasques; Santos; Carvalho, 2012[34]	Video	Punction and heparinization of a fully implanted catheter
	Bloomfield; Roberts; While, 2010[35]	Self-learning module in a computer	Hand washing
	Salyers, 2007[36]	Educational software	Nasopharyngeal aspiration and catheter insertion
	Sung; Kwon; Ryu, 2008[37]	*Blended learning*	Drug administration
	Woolley; Jarvis, 2007[38]	DVD media and closed television circuit	Nursing skills in general
	Bloomfield; Cornish; Parry; Pegram; Moore, 2013[39]	Multimodal course	Nursing skills in general
	Simonsen; Daehlin; Johansson; Farup, 2014[40]	Online course	Drug calculation
	Cogo, Pedro; Silva; Schatkoski, Catalan, Alves, 2009[41]	Hypertext, educational game, simulation	Oxygen therapy
	Kaveevivitchai, Chuengkriankrai, Luecha; Thanooruk; Panijpan; Ruenwongsa, 2009[42]	Virtual learning environment	Vital signs

Chart 2 – Synoptic table of the articles included in the sample. Porto Alegre, 2017 (continuation)

Source: Authors.

On the same line, hybrid teaching practices can be mentioned, that is, face-to-face activities associated to long-distance activities, that involve the theme drug administration[20]. In this study, videos, narratives, quizzes, and images presented in a virtual environment were evaluated, and were considered important by the students for the development of their clinical skills, also considering the practical laboratory activities[20].

Similarly, the mobile apps and educational videos have been a supporting tool to practical skill classes. The DET can present the bases of the procedure, as well as the materials, and the step-by-step conduction of the Nursing technique[22-23]. The presence and use of multiple tools makes the learning process more attractive, allowing for the building of individual and collective learning experiences for the students[21]. The access to DETs outside of the classroom, as a complement to teaching, has been mentioned as a factor that contributes to the acquiring of skills, and has generated a greater satisfaction among the students[23].

The flexibility of digital resources, which can be accessed whenever and however the students prefer, stimulates them to study independently, contributing to their autonomy in the learning process[20]. A digital object that allows for the students to study independently can be used to strengthen the theoretical and technical knowledge in graduation nursing courses[18].

It is worth highlighting that, although the DET are versatile and impacting instruments, their mere presence does not guarantee an effective educational process[27]. That demands nursing teachers to identify the most adequate pedagogical referential for them to have a good DET support. Moreover, the challenge of the professors is in the proposal of DET activities that involve and motivate the students towards a learning process that integrates their experiences and previous knowledge[20].

The third category was titled "The learning of Nursing abilities"[31-42], and it presents the articles that demonstrate that the DET contributes to the acquisition of knowledge and the development of technical skills, without disregarding the importance of the moments of supervised clinical practice.

The teaching of Nursing skills traditionally resorts to expository classes and to the practical demonstration in a teaching lab. The role of the student in this setting is restricted to observing and then repeating the demonstration. Studies have proposed to incorporate the DET in teaching activities, diminishing the time taken in expository classes and repetitive subjects[37]. The creation of

digital tools with the aim of supporting and strengthening the learning process was a useful resource, viable for the teaching of nursing skills, and quite different from the monotonous expository classes[38]. In this context, the students have access to the content, with a more detailed presentation, images with better resolutions, references to the theory that support the procedure, resources that integrate audio and video, exercises that problematize the theme, and that can challenge their curiosity, as they can digitally simulate the procedure before it is ever done face-to-face[31-33, 36]. The face-to-face classes are richer, with the teacher guiding the learning process, clarifying doubts and giving support to laboratory practices. The use of the DET as a tool to improve traditional methods is a valid option, capable of generating a change of attitude in students, focusing on learning.

The DET have been used to prepare for laboratory practices, diminishing anxiety and improving the performance in the moment of the execution of Nursing skills[32]. As a complement for the teaching of abilities, they aided in the theoretical review of the stages to be executed, collaborating with the self-learning of the Nursing student[23].

The creation of a safe environment for practical activities offers students the option to repeatedly conduct the same procedure, allowing mistakes to be a tool for an improvement of their technique, increasing the safety of the students, and, in the future, not risking the health of patients[31]. Preparing a nursing student with proper knowledge and abilities is an essential part of a nurses training. To do so, it is necessary to develop safe practices, so that the needs of the patients are effectively answered[39]. Therefore, the DET can be considered a group of resources that promote meaningful learning and diminish the exposition of patients to health-care-related damage.

FINAL CONSIDERATIONS

In this integrative review, different types of DET were identified in the teaching of Nursing skills. These digital materials make teaching more dynamic and allow for the use of active learning methods, breaking the molds of a traditional teaching, which is focused on demonstrating and repeating procedures.

In the analysis of the articles, it was highlighted that educational technologies contribute to the teaching of nursing skills, improving the acquiring of the theoretical references that subsidize practice. It is important to prepare the students in simulated and virtual realities and to use manikins, so they only conduct the procedure on humans after having demonstrated ability and confidence. This method allows for the self-recognition of eventual mistakes before the procedures of care are applied to a real patient. Hybrid teaching modalities that integrate the DET and manikins in simulated environments are flexible methods that develop critical thought and prioritize the role of the students.

One of the limitations in the adoption of these resources is the high cost for the acquiring or development of the DET, which makes it so that many institutions have no access to them. The permanent education of professors and a strong institutional support can try to diminish that distance, guiding them when it comes to the development of more accessible digital materials, such as videos, for instance.

The recommendations for the teaching process are subsidized on the need of graduation Nursing courses to analyze the most adequate and effective resources to be used in their reality, associating the best possible technology to the most adequate teaching method. Similarly, researches in the area of educational informatics can get closer to nursing practices, developing proposals of high quality digital materials, and presenting a resource that is closer and more reliable for its environment.

As limitations of this study, it should be highlighted that no quasi-experimental studies were found that could allow for a more precise description of the evidences in the investigated theme. The lack of vocabulary standardization, both in the descriptors and in the abilities, also restricted the broadness of the searches.

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