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IMPACTS OF EDUCATION MEDIATED BY DIGITAL TECHNOLOGIES IN CONTINUING EDUCATION IN NURSING: A QUASI-EXPERIMENT

***[1]Pollyana Júnia Felicidade, [2]Aldenora Laisa Paiva de Carvalho Cordeiro, [3]Thaís Santos Guerra Stacciarini, [2]Rosana Huppes Engel, [4]Lúcia Aparecida Ferreira, [4]Marina Pereira Rezende and [5]Maria Célia Barcellos Dalri**

[1]Enfermeira especialista, pós graduanda da Universidade Federal do Triângulo Mineiro (UFTM). Rua Machado de Assis, 2134. Bairro Saraiva – Uberlândia-MG. Brasil

[2]Enfermeira mestre do Hospital de Clínicas da UFTM.Avenida Getúlio Guaritá, Hospital de Clínicas. Bairro Abadia – Uberaba-MG. Brasil

[3]Enfermeira doutora do Hospital de Clínicas da UFTM.Avenida Getúlio Guaritá, Hospital de Clínicas. Bairro Abadia – Uberaba-MG. Brasil

[4]Professora doutora do curso de graduação em enfermagem da UFTM. Rua Frei Paulino, 30 - Nossa Sra. da Abadia, Uberaba - MG, 38025-180

[5]Professora doutora da Escola de Enfermagem de Ribeirão Preto da Universidade de São Paulo. Avenida dos Bandeirantes, 3900. Campus Universitário - Bairro Monte Alegre, Ribeirão Preto - SP - Brasil

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ABSTRACT

The study aimed to assessthe contributions of education mediated by digital technologies toward updating and acquiring knowledge on cardiopulmonary resuscitation in the nursing team of a public teaching hospital in Brazil. It used a quasi-experimental, before-and-after design, with one single group. Data collection, based on information from the Virtual Learning Environment, was through sociodemographicquestionnaires, and pre- and post-tests, after the reading and completion of the informed consent form. The use of technology-mediated education provided a reflective space and stimulated autonomy in studies. This permanent education format effectively contributed to the update/acquisition of the participants' knowledge of the theme, evidenced by the satisfactory performance obtained by a majority of them, with statistical significance.

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INTRODUCTION

The set of maneuvers involving chest compressions and ventilation to maintain cardio-cerebral perfusion in an attempt to restore cardiac function is calledcardiopulmonary resuscitation (CPR). Although critical to saving lives, learning and correctly applying it remain challenging (Ashoor *et al*., 2017). To perform such maneuvers effectively, it is up to the nursing professional to develop skills and acquire up-to-date technical-scientific knowledge on the subject, as he or she is generally responsible for triggering the rest of the team, being the first to confront the CRA (cardiopulmonary arrest) situation (Moura, Lusineide, Danielle, Roxana &Yanne, 2012). From this perspective, specific guidelines have been developed and established by the American Heart Association (AHA) (Kleinman *et al*., 2018), in an attempt to ensure that CRA care is scientifically grounded and executed with quality. These guidelines are constantly updated and revised, with recommendations for 2017 being the most recent. In the health area, the profile related to access to information for professionals and assisted populations has changed, as health services communication networks are amplified, as a consequence of the expansion of internet access in all environments, including hospital institutions (Prado, Peres, &

Corresponding author: **Pollyana Júnia Felicidade,**
Enfermeiraespecialista, pós graduanda da Universidade Federal do Triângulo Mineiro (UFTM). Rua Machado de Assis, 2134. Bairro Saraiva – Uberlândia-MG. Brasil

Leite, 2011). Given the available digital technologies and the need for constant updating of the health team, it is opportune to associate lifelong education, or"learning at work, where learning and teaching are incorporated into the daily life of organizations and work" (Brazil, 2009), with education mediated by digital technologies, also known as distance education. This type of education uses the virtual learning environment (VLE) as a resource and permits alternatives, such as flexibility and timeliness, which preserve individual needs and routines, compared with conventional education, for addressing possible obstacles related to the low adherence of activities and attendance (Badiei, Gharib, Zolfaghari, & Mojtahedzadeh, 2016; Evans, Ellis, Norman, & Luke, 2014). The development of educational programs should be based on professional needs, as low adherence to the activities of permanent education can be related to limitations of time, lack of support for the team, and work commitments. Education mediated by digital technologies emerges as an excellent strategy for the acquisition and updating of knowledge (Shahhosseini & Hamzehgardeshi, 2015). In view of the above, the objective of this study was to verify the contributions of education mediated by digital technologies aimed at the updating and acquisition of knowledge on CPR by the nursing team at a public hospital.

MATERIALS AND METHODS

This quasi-experiment, before and after study with a single groupwas performed in a large public teaching hospital located in the interior of Brazil that offers high complexity care, supported 100% by the Unified Health System (SUS). The study population consisted of nursing professionals from the aforementioned institution. For inclusion criteria, we recruited nursing professionals working in care units and who completed the course on CPR offered through distance education. Professionals who did not take the pre- or post-testwere excluded. For the sample calculation, a pilot study was carried out with 10 participants who were excluded from the final sample. The power analysis was obtained from the pilot study data, which revealed a statistical power of 99% and a knowledge gain from 13.20 to 17.00 (gain of 3.80) and standard deviation of difference of 1.87. Thus, the final sample would be 30 participants. We chose to go beyond and account for all participants who completed the course during data collection. Data were gathered from April 6 to November 13, 2018, based on VLE data, using sociodemographic questionnaires and pre- and post-tests. The sociodemographic variables were professional category, sex, age, higher education in the health area, work shift, and other employment relationships. Cognitive ability (knowledge) was the outcome variable of this study and was verified through an instrument elaborated by the authors, with 20 multiple-choice questions, in which only one alternative was correct and one point value was given for each question.

It was based on the 2017 AHA guidelines and developed specifically for this study. It was submitted to seven specialist nurses and pilot tested for adjustments in appearance and content. The instrument was applied in two different moments, namely, shortly after enrolling, before entering the course, and beginning to follow the schedule (pre-test); and immediately after completing the course (post-test). A cut-off score of 14 points, or 70% accuracy, was adopted as a performance classification criterion in the post-test, considered good performance. Scores lower than 14 (less than 70% of performance) were considered unsatisfactory. The data were tabulated using an Excel worksheet and analyzed using SPSSversion 20.0. Descriptive statistics were used for measures of central tendency, distribution of absolute and percentage frequencies, and dispersion for sociodemographic variables. Student's *t*-test was used to compare the mean obtained by the participant before and after the intervention. The level of significance of $p < 0.001$ was adopted. Participation in the research was voluntary, after reading, completing and signature the informed consent. This study was appraised and approved by the Research Ethics Committee of a public university inBrazil, under legal brief 1,501,916.

Intervention

The development of this educational proposal was grounded in the process of instructional design, which is characterized by a set of activities aimed at providing solutions to problems identified in learning. This process, when divided into small phases, is called the analysis, design, development, implementation, and evaluation (ADDIE) model. The design involves the three first stages, and the implementation of the remaining two (Filatro, 2008).

Basedon the the ADDIE model (Filatro, 2008), we adopted the following:

Analysis*:* In the analysis of learning needs, the target audience and contextual constraints were determined. Considering that the Nursing Education Service of the institution in question regularly offers, among other activities, training and theoretical-practical courses for the nursing team, frequent poor attendance at the face-to-face training offered was observed, regardless of the theme.

Design: In designing the presentation of the contents, the Moodle VLE belonging to the university linked to the teaching hospitalwas utilized. With it, it was possible to break down the content into several blocks, to which were added topics with materials and virtual educational activities. The types of language used were verbal and non-verbal, and figures and/or symbols were easily identified by the participants.

Development: This was based on a review of the literature on the subject and the 2017 guidelines of AHA, which permitted the drafting of the lesson plan. The course was structured in 10 topics: a) presentation and initial information; b) pre-test; c) basic concepts and causes of CRA; d) CPR in adults; e) particularities in neonatal and pediatrics; f) immediate care after CRA; g) nursing team performance in the care of the CRA patient; h) clinical case simulation; i) complementary material; and j) post-test and course evaluation. All content, and the course resources, were submitted to the seven specialist nurses. Moodle provides activities and resources for the development of a VLE. For the present study, the following activities were used: forum, questionnaire, and evaluation research. The resources applied were the file and URL. Through these mechanisms, teaching materials were prepared by the researchers, based on the AHA 2017 guidelines, videos available on YouTube, and scientific articles. The course presented a topic with the provision of a clinical case to simulate victim care in CRA. Microsoft PowerPoint 2016 was utilized. While it was being presented, the students received instantaneous feedback, in accordance with their actions (clicks), making the activity interactive.

Table 1. Numerical frequency and percentage of nursing professionals who took the mini-course in cardiopulmonary resuscitation through distance education, according to selected sociodemographic variables, Uberaba, Minas Gerais, 2018

Variable	Frequency (n)	Percentage (%)
Professional category		
Nurse	28	50,9
Technical / Nursing Assistant	27	49.1
Sex		
Female	44	80
Male	11	20
Age group		
23 to 30 years old	19	34.5
31 to 40 years old	25	45.5
41 to 50 years old	09	16.4
≥51 years old	02	3.6
Highest level of education in the health field		
High school / technical	16	29.1
Higher education	12	21.8
Master's degree	04	7.3
Doctorate	01	1.8
Specialization	22	40
Work shift		
Morning	21	38.2
Afternoon	17	30.9
Night	15	27.3
8 hours	02	3.6
Other job link		
Yes	03	5.5
No	52	94.5

Implementation: The course started on April 6, 2018 and was disseminated on a website and in a monthly magazine published by the hospital complex. The schedule and the distribution of leaflets and explanatory folderswere ensured in each hospital sector.

Evaluation: In addition to the evaluations carried out in the developmental stage and the use of more objective resources, such as one single questionnaire for the pre- and post-test (with the intention of ascertaining the knowledge acquired by the students), there were collaborative environments, with appropriate challenges for the participation and collective construction of knowledge among the students. There were also shared forums for reflection and encouragement for drafting proposals that would permit possible solutions to the difficulties identified by the colleagues concerning victim care in CPR.

RESULTS

Fifty-five professionals from the nursing team participated in the research. They had a mean age of 34.78 years, and ranged from 23 to 53 years.Table 1presents the characteristics of the sample. The sectors with the largest number of employees were Orthopedics, with 15 (27.3%); Adult Emergency Room, 9 (16.4%); Neurology, 9 (16.4%); and Neonatal Intensive Care Unit, 5 (9.1%). Regarding professional experience, the average work experience in the area was 8.27 years. On extracurricular courses or activities on CPR, 40 (72.7%) participants reported previous participation in activities in this thematic area. The average of the pre-test score was 13.58, with a minimum of 5 and a maximum of 20 points. The mean post-test score was 16.56, with a minimum score of 10 and a maximum score of 20 points. Thus, the educational intervention was effective, as the percentage of the general mark of the participants went from 13.58 (67.9%) in the pre-test to 16.56 (82.8%) in the post- test, and the difference was statistically significant ($p < 0.001$), which indicates a contribution to the knowledge of these professionals, visualized by the increase in the number of correct answers.

The number of participants who achieved good performance (≥70% of correct answers) in the post-test was 45 (81.81%). In addition, no associations (with statistical significance) were identified between socio-demographic data and post-test performance.

DISCUSSION

The educational intervention adopted in the present study allowed the total integration of the students, providing an environment for reflection on the subject and stimulating clinical reasoning and decision making.Among the 55 professionals participating in the study, women predominated. Nursing, by tradition and culture, has always contributed to the feminization of health, in a scenario where this sector has been structurally and historically female for many decades (Machado, 2016). There was little participation of people aged 51 years or over. Brazilianssurvey (Machado, 2016) characterized the phases of professional life; and among them, it is assumed that people over the age of 51 years are in the so-called "professional deceleration" and "retirement" phases. In the former phase, choices are madefor personal fulfillment, and there is no longer as much interest in venturing into new jobs or professional activities; indeed, ensuring retirement becomes a priority. In the latter, people opt for tasks that bring them convenience, pleasure, and personal recognition, as they are preparing to leave the labor market (Machado, 2016). The difficulties involved in the pursuit of educational activities are not only related to age but also to double shifts (Coventry, Maslin-Prothero, & Smith, 2015). In this study, the majority of professionals did not have other jobs; this was a potential factor for good performance, as participation in professional improvement opportunities will depend directly on leadership and managerial style, daily staff restrictions, and workload (Coventry, Maslin-Prothero, & Smith, 2015), be it in exclusive dedication or parallel jobs. Most of the participants had previously taken courses on the proposed topic. The more repetition the learner performs, the better his or her performance in the maneuvers of CPR (Ruijter, Biersteker, Biert, Van Goor, & Tan, 2014). Abolfotouh,

Alnasser, Berhanu, Al-Turaif, and Alfayez (2017) showed that recent exposure to training or studies in CPR yields positive results in the evaluation of knowledge of victim care in CRA. However, from the results of the present study, no relevantdifference in performance was seenbetween participants who had taken some courses in the subject previously and those who had not. This corroborates the findings inanearlier study (Tobase, Peres, Tomazini, Teodoro, Ramos, & Polastri, 2017b): gains in student learning are equivalent, regardless of prior participation in courses in the same subject.The assertion that the traditional classroom teaching method has lost strength in terms of plurality of teaching modalities (Tobase, Peres, Gianotto Oliveira, Smith, Polastri, & Timerman, 2017a) may be related to the fact that technology-mediated education favors the acquisition and/or updating of subjects. Online courses stimulate participants'autonomy, which in turn favors self-knowledge in the self-instructional learning process, combining the assumptions of andragogy and significant learning theory (Tobase *et al*., 2016b). In addition, students are satisfied with the online method, which permits them to work at their own pace and review the content when necessary, and where information is made available in a more direct way, which makes adequate study time feasible (Serwetnyk, 2015).

A study (Tobase *et al*., 2016b) conducted in Brazil showed that learning and self-efficacy during the care provided in CRA increase with the frequent use of short instructional videos; therefore, they could be used in education. Another study (Nord, Svensson, Claesson, Herlitz, Hult&Kreitz-Sandberg, 2017), conducted in Sweden, found that videos and online courses with a conceptual approach improve students' theoretical knowledge, but not practical CPR skills. Thus, the results obtained in the present study are in line with the literature concerning the improvement of scientific knowledge through digital technologies. A studyconducted in the United Kingdom (Padilha, Suthers, Granero-Molina, &Fernández-Sola, 2015) on basic life support and the use of the external automatic defibrillator had two groups, one self-directed and one led by an instructor. In both strategies,cognitive knowledge showed a significant improvement after the intervention; however, when the post-test and retention of knowledge were evaluated, the success rates decreased significantly for the instructor-led group, which did not happen with the self-directed group. CPR training has several formats, such as instructional or self-instructional kits, practical or theoretical video-based applications, and education mediated by digital technologies (Nord, Svensson, Claesson, Herlitz, Hult & Kreitz-Sandberg, 2017). Thus, in view of the vast availability of technologies and their insertion into the daily life of humans, the most diverse modalities and formats should be tested and combined for achieving success in teaching-learning and permanent education. Combined face-to-face and distance formats are as effective as face-to-face training only (Castillo, Gallart, Rodríguez, Castillo, & Gomar, 2018; Serwetnyk, 2015). Combined formats (blended learning) provoke the improvement of some observed aspects, although the research is still incipient and requires replications in other populations.With the insertion of these technologies, including wireless networks, in health training, there is also the possibility of taking the representation of victim care in the CRA to the work environment, in this case, intra-hospital and within *in situ*simulation (Melo, Falbo, Bezerra, & Katz, 2018). However, preparing this program type can present dimensional challenges, such as those of a technical, administrative, logistical, cultural, and financial nature (Sorensen, 2017). Education mediated by digital technologies may present the risk of some students demonstrating difficulties in establishing a student–teacher social connection; therefore, the VLE needs to be deliberatelycreated as a welcoming space with the intention of strengthening these relationships. In the case of nursing, the participation of the instructor who intends to care for it may be a potential factor in the preparation of aVLE that preserves the characteristic features of the area: care for the individual (Gdanetz, Hamer, Thomas, Tarasenko, Horton-Deutsch, & Jones, 2018). This study presented limitations. It used only the virtual environment; meanwhile, the association with practical simulations and the personal intervention of an instructor can exponentially increase the absorption of content, considering that discussions can be extended and practical skills trained.Further studies in the areaare suggested, with research on education mediated by digital technologies and the inclusion of periodic activities, using combined methodologies associating VLE with classes considered traditional, ortaught personally by a professor, in the permanent education of the nursing team. In this way, the professional will be in constant learning mode, keeping up to date withthe frequent updates in the health area, to become even more qualified in their work.

Conclusion

The use of technology-mediated education proved to be successful at providing a reflective and stimulating space for study autonomy. This permanent education format effectively contributed to the updating/acquisition of knowledge, evidenced by the good performance, with statistical significance, obtained by a majority of the participants.

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