

# Effectiveness of an educational website to enhance knowledge about pressure injuries: quasi-experimental study

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## ABSTRACT

**Background** Traditional teaching has proven insufficient to provide nurses with the necessary knowledge about pressure injuries. Therefore, alternative educational methods, such as online platforms, are being explored to improve nursing education.

**Aim** To evaluate the effectiveness of an online website to improve nursing students' knowledge of pressure injuries and determine their level of satisfaction with this teaching method.

**Methods** A quasi-experimental design with quantitative analysis of pre- and post-tests and satisfaction scores was used.

**Sample** Senior undergraduate nursing students (N = 51) from 10 public and private Brazilian universities participated.

**Data collection** The Pressure Injury Knowledge Test was used, consisting of 41 questions on pressure injury assessment and classification and 12 questions on management. The Student's Satisfaction with Learning Questionnaire assessed students' satisfaction. The educational website content was organised into various pressure injury modules, validated by specialists, and offered as a distance course. Students completed pre- and post-tests to compare the effectiveness of learning from the website.

**Data analysis** The student t-test was used, with statistical significance set at  $p < 0.05$ .

**Results** The percentage of correct answers on the post-test (91.53%) was higher than on the pre-test (73.77%) ( $p < 0.01$ ). In the post-test, four questions in the domain 'Pressure Injury Management' had success rates between 59% and 66.7%, indicating a lack of knowledge. The average student satisfaction with their knowledge increased ( $p < 0.01$ ).

**Conclusion** The intervention significantly increased the rate of correct answers, suggesting that online platforms can effectively enhance knowledge and satisfaction in nursing education.

**Implications for clinical practice** Online educational resources can improve nursing education in critical areas like pressure injuries, contributing to better patient care.

**Keywords** pressure injury, knowledge translation, nursing students

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## KEY MESSAGES

- **Educational interventions improve nursing knowledge:** This study demonstrates that online educational interventions effectively enhance nursing students' knowledge and satisfaction, particularly in pressure injury prevention and management.
- **Impact of online learning on nursing students:** The aim of the study was to evaluate the effectiveness of an online website in improving nursing students' knowledge of pressure injuries and assessing their satisfaction with this method. The results indicated a significant increase in knowledge, with post-test scores significantly higher than pre-test scores ( $p < 0.01$ ).

- **Satisfaction and knowledge improvement:** The educational website was shown to increase both knowledge and satisfaction with pressure injury management. Students demonstrated improved knowledge, especially in pressure injury assessment and prevention, with satisfaction scores increasing after the online intervention.

## INTRODUCTION

A pressure ulcer is localised damage to the skin and tissues caused by the combination of pressure and shear. The injury often occurs in bony prominences and can also be caused by devices used for health care.<sup>1</sup> Researchers around the world

study the occurrence of pressure ulcers and reinforce the need for preventive measures to reduce their high incidence. A systematic review and meta-analysis of hospital-acquired pressure ulcer included studies from several countries and identified a worldwide incidence of 12%.<sup>2</sup> In Brazil, a study identified an incidence greater than 18% among hospitalised patients.<sup>3</sup>

Pressure ulcers cause significant negative effects because they hinder the process of functional recovery, which complicates and worsens the overall health condition. Furthermore, pressure ulcers are associated with prolonged hospitalisations, sepsis, mortality, high financial costs for the institution and increased workload for the health team.<sup>1,3</sup>

The literature has highlighted healthcare teams' limited use of clinical guidelines for prevention and treatment of pressure ulcers and generalist nurses' lack of knowledge on this topic.<sup>4</sup> Previous studies state that while nursing students receive theoretical knowledge about pressure ulcers, they are often exposed to outdated and inaccurate information about intervention in their clinical placement.<sup>5-7</sup> Thus, the authors highlight the importance of nursing programs in including clinical guidelines in the curriculum, thereby equipping nursing students with the correct knowledge about pressure ulcers and encouraging them to draw on available evidence and current therapies.<sup>5-7</sup> To improve nursing clinical practice and patient outcomes, it is essential to implement teaching strategies that are well received by the students and favor the dissemination and implementation of national and international clinical guidelines for the prevention and management of pressure ulcers.<sup>1,4</sup>

Current web-based distance learning in nursing education can be as effective as face-to-face teaching and is well accepted among learners.<sup>8</sup> Web-based distance learning can also promote satisfaction and self-confidence related to learned content.<sup>8</sup> Using online educational platforms can assist in translating knowledge gained about pressure ulcers into clinical practice.<sup>8</sup> Nursing students' lack of or inadequate knowledge of the prevention and treatment of pressure ulcers results in unsafe practices and brings harm and suffering to patients and their families.<sup>9</sup> Despite the advances in technology and the dissemination of evidence-based practice, a gap still remains between theory and clinical practice in nursing, unmistakably revealed by the high incidence of hospital-acquired pressure ulcer across the world.<sup>10,11</sup>

As the future of professional health care, it is essential to invest in the education of nursing students to help them gain confidence in implementing safe, compassionate, and competent care.<sup>7-9</sup> Granted, students acquire knowledge and attitudes about pressure ulcers early in nursing education and have opportunities to participate in workshops related to this topic.<sup>12</sup> However, studies that assess students' satisfaction with their knowledge about pressure ulcer can contribute to improving their self-confidence in implementing preventive measures.<sup>12,13</sup> Self-confidence can drive changes that improve quality of care and lead to better outcomes.<sup>13</sup> Study findings related to knowledge application and learners' satisfaction level can serve as parameters to identify whether learning objectives have been achieved or not and to assess the quality of the educational intervention and its ability to impact clinical practice.<sup>14</sup>

The goal of nursing programs is to prepare future nurses to acquire and translate knowledge into practice to improve population' health, outcomes and wellbeing. Thus, the purpose of this study was to evaluate the effectiveness of using an online tool to teach nursing students about prevention and management of pressure ulcers and to compare their knowledge before and after using this tool, as well as their satisfaction with the acquired knowledge.

## METHODS

### Study design

A quasi-experimental study of a single group was used to evaluate students' knowledge of pressure ulcer before and after participating in a web-based educational program (intervention). Authors investigated the effect of the independent variable (use of an educational website) on the dependent variables (students' scores on the knowledge test and student's satisfaction with learning). In this type of study, the expected outcome is that students' knowledge and satisfaction will improve after the implementation of the intervention.<sup>15</sup> Therefore, the main hypothesis of this study was: Does a web-based educational program on pressure ulcer prevention and treatment contribute to improve students' knowledge and satisfaction with their learning?

### Setting

This study was carried out between November 2018 and January 2019 in 10 nursing programs in public and private universities in Brazil, which operate under two distinct systems. Admission to public universities generally requires passing a competitive entrance examination.<sup>19</sup> These institutions receive government support to invest in faculty development and research production.<sup>19</sup> In contrast, private universities often have a greater focus on teaching rather than research activities.<sup>20</sup>

### Sample recruitment

The authors contacted the coordinators of undergraduate nursing programs at the 10 universities in Brazil and asked them to share the study's invitation with their students. To be included in this purposive sample, participants had to meet the following criteria: 1) be a student in the senior year of the undergraduate nursing program at one of the 10 public or private higher education institutions in the state of São Paulo, Brazil; 2) participate in the online course; 3) answer research instruments before and after the course; and 4) sign to grant informed consent.

The study protocol was reviewed and approved by the Research Ethics Committee of all 10 participating institutions, in accordance with Brazilian legislation regulating ethical research involving human subjects.

### Educational website design (Intervention)

The educational website was organised into five modules: 1) patient safety; 2) pressure ulcer prevention; 3) interventions for pressure ulcer prevention and treatment; 4) pressure ulcer management, and 5) complementary recommendations for the care of patients with greater vulnerability for pressure ulcer. The content was developed based on a synthesis of clinical practice guidelines from the National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP) and Pan Pacific Pressure Injury Alliance (PPPIA)<sup>16</sup>

and the proposal of the NPUAP on the skills of nurses for the prevention of pressure ulcers.<sup>17</sup> A panel of nurses and information technology professionals validated the website's content and quality.<sup>18</sup> At the end of the research, the educational website was available on the internet with free access at the electronic address [www.eerp.usp.br/feridasronicas](http://www.eerp.usp.br/feridasronicas).<sup>18</sup>

## DATA COLLECTION

Data were collected at two points: at the beginning of the study and after the intervention between November 2018 and January 2019. A digital platform developed for that purpose contained the research instruments and the educational website accessed by participants by registering with a username and password. After answering the demographic and educational questions, participants were given the pre-test, namely the Knowledge Test (KT) that examined their knowledge about pressure ulcer. Students had access to the content about pressure ulcers only after completing all the questions of pre-test. Then the access to the content about pressure ulcers was restricted, and they were invited to answer the post-test for the KT and the Satisfaction with Learning Questionnaire. Upon completion of the questionnaires they received a certificate of participation. Participants could interrupt the course and resume later, as needed, with no time limit. Data collection was concluded upon the final student's completion of the KT and the Satisfaction with Learning Questionnaire. Data were stored on the digital platform and later exported for analysis.

## STUDENTS' KNOWLEDGE OF PRESSURE ULCER

The KT consisted of 53 items. Of these, 41 were adapted from the Pressure Ulcer Knowledge Test Caliri-Pieper (PUKT Caliri-Pieper).<sup>21,22</sup> Eight items refer to the pressure ulcer assessment and classification domain and 33 to the pressure ulcer prevention domain. The remaining 12 items, addressing pressure ulcer management and topical therapy, were adapted from the Pieper-Zulkowski Pressure Ulcer Knowledge Test (PZ-PUKT).<sup>23,24</sup> Both the PUKT Caliri-Pieper and the PZ-PUKT were validated in Brazil with the consent of the author.<sup>22,24</sup> The total score on the KT was obtained by adding the number of correct answers to the 53 items of the test and calculating the average percentage of correct answers. A higher score demonstrated higher knowledge of pressure ulcer. The investigation by Cronbach's  $\alpha$  of the 53 items of the test identified a value of 0.61, which demonstrates the adequate internal consistency of the questions.<sup>25</sup>

## STUDENTS' SATISFACTION WITH LEARNING

The Students' Satisfaction with Learning Questionnaire (Table 1) included 20 items related to the content covered in the five modules on the educational website. Each item was scored on a five-point rating Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied). The items involved topics such as patient safety, assessment, classification, prevention and management of pressure ulcers. Additional items included assessments of skin and tissue, nutrition care, repositioning, pain and infection management, and healing. Satisfaction scores were calculated by summing the responses of participants who reported being satisfied with each topic. A higher score reflected higher satisfaction. The Cronbach's  $\alpha$  (= 0.975) was calculated, demonstrating high internal consistency for the learning subscales.<sup>25</sup>

## DATA ANALYSIS

Demographic variables were examined with descriptive statistics. For comparisons of scores between KT and Students' Satisfaction with Learning Questionnaire of paired samples, the Student's t-test was used.<sup>26</sup> All analyses were performed using the SAS® version 9.4 statistical software.<sup>27</sup> The level of statistical significance was set at  $p < 0.05$ .

## RESULTS

A total of 108 students enrolled in the intervention. Of these, 98 (90.7% of enrollees) completed the pre-test and 51 (52% of pre-testers) completed the post-test and the satisfaction questionnaire comprising the final research sample.

The average age was 28.8 years, the standard deviation (SD) was 7.8. Most students (74.5%) were enrolled at a public university and 82.3% were female.

The average of students' scores on the KT was 73.77 (SD=7.57) on the pre-test and 91.53 (SD=8.42) on the post-test, indicating a statistically significant improvement ( $p < 0.01$ ). Score differences between the pre- and post-test were observed across the three KT domains: assessment, prevention, and management of pressure ulcer (Table 2).

In the post-test, within the pressure ulcer management domain, students demonstrated limited knowledge on four items, with correct response rates ranging from 59% to 66.7% demonstrating a lack of knowledge of the subject. These items were "Alginate dressing can be used for pressure ulcer with too much exudate or with clinical evidence of infection" (56.86%); "Hydrocolloid dressing should not be used on infected wounds" (60.78%); "Pressure ulcers can be cleansed with water that is suitable for drinking" (64.71%); and "Dry, adherent eschar on the heels should not be removed" (66.67%).

Post-test results showed an increase in the number of students achieving  $\geq 90\%$  correct answers on the KT, with no participants scoring below 70% (Figure 1).

The average student satisfaction score regarding their knowledge before the intervention was 70.78 (SD=29.28), increasing to 93.92 (SD=20.89) after the intervention, with a statistically significant difference ( $p < 0.01$ ).

The results supported the hypothesis that the web-based educational program on pressure ulcer prevention and treatment contributes to improving students' knowledge and satisfaction with their learning.

## DISCUSSION

The findings of this study have demonstrated that a web-based distance educational intervention can improve the knowledge of nursing students about the prevention and management of pressure ulcers, thus improving the satisfaction with their learning experience and acquired knowledge. Therefore, this type of intervention is an adequate way of translating knowledge into practice and has the potential to improve quality of care and patient safety.

This study presented some limitations. The sample loss should be considered in future studies. Participant retention strategies should be investigated to mitigate sample attrition, thereby allowing for more robust data analysis. The study had only two time points (pre-test and post-test), thus preventing observation of the intervention's sustained effect.

Of the 98 pre-test participants, only 51 (52.04%) completed the online course as shown by their participation in the post-test. The reason for the reduced participation at the end of the online course remains unclear. The timeline of data collection contributed, due to its proximity to the end of the term where students are busy with course completion and final exams. This situation corroborates that of authors who affirm that the proximity to the end of the academic year leaves students involved in other academic activities that may affect completion of voluntary research participation.<sup>28</sup>

Most of the participants in the present study were female, which is similar to other studies carried out with nursing students or professionals.<sup>29,30</sup> Regarding age, the average sample studied was 28.8 (SD=7.8) from students in the last year of the course, which is similar to the study done by Gunningberg and colleagues,<sup>6</sup> developed in Sweden,

in which the average age of participants in the same academic period was 30.5. Another study, developed with students from the last year of their nursing course in Iran showed the participants' average age of 22.4.<sup>7</sup> Cowan and colleagues<sup>31</sup> developed a cross-sectional, descriptive study with the objective of describing the experience, training, and educational needs and preferences, as well as the perceptions of education about the prevention of pressure ulcer by caregivers in which the response rate of the online questionnaire was low (24%), as in the present study.

The results of this study indicate that the educational website was effective in improving participants' knowledge scores across three domains: assessment, prevention, and management of pressure ulcers. The differences between pre-test and post-test scores were statistically significant ( $p < 0.01$ ). However, the questions in the pressure ulcer

Table 1. Students' satisfaction with learning questionnaire

Content	Not satisfied	Somehow satisfied	Satisfied	Very satisfied	Completely satisfied
	1	2	3	4	5
1. Patient safety					
2. Definition and etiology of pressure ulcer					
3. Pressure Ulcer Classification System					
4. Prevalence and incidence of pressure ulcer					
5. Risk factors and pressure ulcer risk assessment					
6. Skin and tissue assessment					
7. Skin care for pressure ulcer prevention					
8. Dressings/coverings to protect skin at risk					
9. Assessment of nutritional status					
10. Repositioning a bedridden patient					
11. Repositioning a seated patient					
12. Repositioning to prevent and treat pressure ulcers in the heels					
13. General recommendations for the use of support surfaces (mattresses)					
14. Risk assessment for device-related pressure ulcer					
15. Prevention of medical device-related pressure ulcer					
16. Assessment of pressure ulcer					
17. Assessment of healing (process)					
18. Pain management related to pressure ulcers					
19. Dressings/coverings for pressure ulcer management					
20. Management of pressure ulcer with infection and/or biofilm					

Table 2. Average percentage of correct answers by Knowledge Test: pre- and post-test (n=51)

	Average percentage of correct answers		Test* and p value
	Pre-test	Post-test	
KT domain	Mean (SD)	Mean (SD)	
Assessment and classification of PU	75.98 (12.71)	94.36(8.03)	<0.01
PU prevention	75.7 (8.67)	95.66(7.1)	<0.01
PU management	66.99 (11.9)	78.27(18.26)	<0.01
Total score on the Knowledge Test	73.77 (7.57)	91.53(8.42)	<0.01

\* Paired Students' t-test  
SD = standard deviation  
PU = pressure ulcer

management domain did not reach an average of satisfactory answers (greater than or equal to 90%), demonstrating that some participants were unfamiliar with some of the questions, indicating knowledge gaps. The results may have been influenced by the presentation of this complex topic at the end of the educational website content, following the other topics, which may have led to cognitive overload or participant fatigue. Similar results were found in studies that also used the PZ-PUKT knowledge test. For instance, participants in Fulbrook, Lawrence, and Miles's study<sup>32</sup> presented lower performances in the same domain (59%)<sup>32</sup>, as did those in the Delmore and colleagues study,<sup>33</sup> who achieved lower (74%) scores on the same theme. The low performance in the pressure ulcer management domain may relate to the limited opportunities nursing students have to practice management of pressure ulcers during their clinical placement. Low performance in this category also implies the need to continue improving knowledge post nursing programs by enrolling in specialised wound care programs. Advancing nursing practice through specialty programs would provide nurses with more clinical practice opportunities and thus improve the ability to manage pressure ulcers with appropriate knowledge, experience, and techniques.<sup>29</sup> This context also highlights the importance of integrating this topic into the undergraduate nursing curriculum to enhance education on pressure ulcer management.

The present study also demonstrated that using the educational website to search for information on the topic of pressure ulcer improved nursing students' performance on the knowledge assessment test. While studies with nursing students are scarce, studies with nursing professionals corroborate the findings of the present study. For example, Lee and colleagues<sup>34</sup> developed a study with the objective of evaluating the effect of a face-to-face lecture on the pressure ulcer classification system on the knowledge of 407 nurses and on the visual differential diagnosis capacity of the pressure ulcer classification. They found that the overall

mean difference in knowledge increased significantly after the educational intervention ( $p < 0.05$ ).<sup>34</sup> Investigators in another study assessed the knowledge of 57 health professionals before and after an interactive educational intervention on pressure ulcer and found a statistically significant increase in knowledge scores about pressure ulcers after the intervention.<sup>33</sup> A study also developed in Brazil verified the effectiveness of an active and hybrid educational intervention by assessing the knowledge of 95 nurses about pressure ulcer prevention, which obtained an average of 78.8% correct answers on the pre-test and 88.8% on the post-test, with a statistically significant difference ( $p < 0.001$ ).<sup>35</sup>

Bredesen and colleagues<sup>36</sup> developed and tested an e-learning program for risk assessment and pressure ulcer classification. Forty-four nurses who worked in hospital acute care units or long-term institutions participated in the study. Participants were randomly assigned to two groups: an e-learning program group (intervention) and a group of traditional classroom lectures (control). They found that, immediately after online training, the intervention group performed better than the control group. The authors concluded that an e-learning program had a greater effect than traditional classroom teaching in the short term.<sup>36</sup>

In this study, participants demonstrated increased satisfaction with their knowledge about pressure ulcers after participating in the educational intervention. These results corroborate those of Henry,<sup>37</sup> who developed a study with the objective of increasing the knowledge and competence of the nursing team in the prevention of pressure ulcers in a hospital, and measuring the satisfaction and effectiveness of an online educational program for increased patient safety. The results showed an improvement in the performance averages before and after the intervention, with statistically significant differences ( $p < 0.05$ ); and on average, 68% of the participants were satisfied with their knowledge after the training.<sup>37</sup> Satisfaction with the learning is an important factor that can

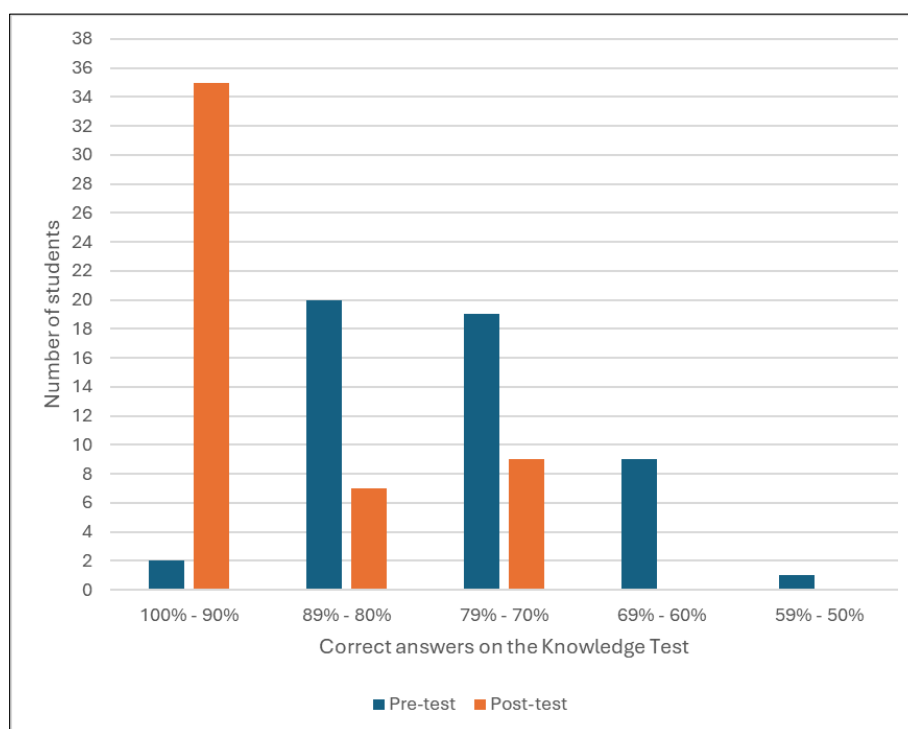


Figure 1. Number of participants and percentage of correct answers on the Knowledge Test: pre- and post-test (n=51)

influence self-confidence and the experiences that will shape the performance of the future professional; therefore, teaching methods that engage and motivate students to learn should be implemented.<sup>38</sup>

## IMPLICATIONS FOR EDUCATION AND CLINICAL PRACTICE

The KT can be used as a tool for formative assessment, as it includes items covering essential knowledge for nurses' educational and clinical practice. Assessing nursing students' knowledge about pressure ulcers allows educators to implement strategies to enhance specific aspects of the topic and improving students' opportunity to deliver care during clinical practice.<sup>30</sup>

The findings showed that the average percentage of correct answers from participants at private universities was higher than those from public universities and the difference was statistically significant ( $p < 0.001$ ). Further studies are recommended to investigate the factors influencing knowledge of nursing students between public and private universities. Understanding students' level of knowledge is essential to foster discussion and updates in the nursing curricula of both educational systems. Improving nursing curriculum by incorporating key components that present the greatest challenges in clinical practice (such as pressure ulcers) is crucial for preparing future nurses to deliver safe and high-quality patient care. Regardless of educational system institutions and faculty have the responsibility to promote and implement the best practice into the nursing curriculum to prepare future nursing professionals.<sup>7,36</sup>

Innovative education strategies related to pressure ulcers should be implemented in both clinical practice and academic training settings to increase patient safety and care quality across the continuum.<sup>6</sup> Teaching strategies for pressure ulcer prevention and management should go beyond traditional models to improve knowledge acquisition during nurse training. Distance education strategies, being both innovative and widely accessible, play an important role in advancing nursing practice. These strategies also have the potential to prepare a large number of individuals in wound prevention and management.<sup>36</sup>

Measuring knowledge scores before and after the educational intervention must be considered to identify knowledge gaps<sup>32</sup> and determine whether learning objectives have been achieved. Innovative education methods are necessary to engage and motivate adult learners to improve knowledge and improve clinical practice. Similarly, experimental studies must be conducted to identify the effects of innovative education strategies<sup>34</sup> and promote improvement as necessary.

Future studies using the educational website are recommended to further evaluate the impact of online tools on improving students' knowledge and satisfaction. This includes randomised controlled trials, longitudinal studies on knowledge retention and investigations into user experience with digital platforms.

## CONCLUSION

The educational website demonstrated effectiveness in improving nursing students' knowledge regarding the

prevention and management of pressure ulcers, as well as in increasing their satisfaction with learning. As an auxiliary tool, distance education has the potential to contribute to knowledge translation and dissemination in a large target audience, overcoming the barriers of space and time.

The findings of this study can inform curriculum development and clinical practice. Including meaningful educational strategies into nursing programs will better preparing future nurses to promote patient safety and quality of care.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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