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Development of WebQuest to prevent incidents related to medication administration

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Desenvolvimento de WebQuest para prevenir incidentes relacionados à administração de medicamentos

Desarrollo de WebQuest para prevenir incidentes relacionados con la administración de medicamentos

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ABSTRACT

Objective: To develop an educational WebQuest to prevent incidents related to medication administration.

Method: Methodological study of construction and evaluation, developed in two stages: Construction of technology with identification of domains and generation of items for the Assessment Instrument. The technology assessment involved three phases: Content Assessment by Experts; Review and Reformulation; Pilot test. 15 experts participated in the content evaluation, and 35 nursing professionals participated in the pilot test. In data analysis, the Content Validity Ratio was applied, considered valid when the index reached > 0.600 in the first round and > 0.778 in the second.

Results: The WebQuest presented adequate indexes regarding technical aspects (> 0.87) and pedagogical aspects (1.0) in the first round of evaluation, while the Instrument was considered adequate (> 0.78) after the second round. The proportion of correct answers was significantly higher after browsing the WebQuest (p-value <0.001), increasing from 31.63% in the pre-test to 87.76% in the post-test.

Conclusion: The WebQuest and the Knowledge Verification Instrument had their contents considered adequate by experts. The WebQuest proved to be an effective educational tool to expand the nursing team's knowledge on preventing incidents in medication administration.

Descriptors: Patient safety; Health education; Medication Errors; Nursing; Educational Technology.

RESUMO

Objetivo: Desenvolver uma WebQuest educativa para prevenção de incidentes relacionados à administração de medicamentos.

Método: Estudo metodológico de construção e avaliação, desenvolvido em duas etapas: A construção da tecnologia com Identificação de domínios e geração de itens do Instrumento de Avaliação. A avaliação da tecnologia envolveu três fases: Avaliação de Conteúdo por Especialistas; Revisão e Reformulação; Teste-piloto. Participaram da avaliação do conteúdo 15 especialistas, e do teste piloto, 35 profissionais de enfermagem. Na análise dos dados aplicou-se o Content Validity Ratio, considerado válido quando o índice alcança > 0,600 na primeira rodada e > 0,778 na segunda.

Resultados: A WebQuest apresentou índices referentes aos aspectos técnicos (> 0,87) e pedagógicos (1,0) adequados já na primeira rodada de avaliação, enquanto o Instrumento foi considerado adequado (> 0,78) após a segunda rodada. A proporção de acertos foi significativamente maior após a navegação pela WebQuest (p-valor <0,001) passando de 31,63% no pré-teste para 87,76%. no pós-teste.

Conclusão: A WebQuest e o Instrumento de Verificação do Conhecimento tiveram seus conteúdos considerados adequados pelos especialistas. A WebQuest demonstrou ser uma ferramenta educativa eficaz para ampliar o conhecimento da equipe de enfermagem sobre a prevenção de incidentes na administração de medicamentos.

Descritores: Segurança do paciente; Educação em saúde; Erros de medicação; Enfermagem; Tecnologia Educacional.

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RESUMEN

Objetivo: Desarrollar una WebQuest educativa para prevenir incidentes relacionados con la administración de medicamentos.

Método: Estudio metodológico de construcción y evaluación, desarrollado en dos etapas: Construcción de la tecnología con Identificación de dominios y generación de ítems para el Instrumento de Evaluación. La evaluación de la tecnología constó de tres fases: Evaluación de Contenidos por parte de Expertos; Revisión y Reformulación; Prueba piloto. En la evaluación de contenidos participaron 15 expertos y en la prueba piloto 35 profesionales de enfermería. En el análisis de los datos se aplicó la Razón de Validez de Contenido, considerada válida cuando el índice alcanza > 0,600 en la primera ronda y > 0,778 en la segunda.

Resultados: La WebQuest presentó índices adecuados en aspectos técnicos (> 0,87) y pedagógicos (1,0) en la primera ronda de evaluación, mientras que el Instrumento fue considerado adecuado (> 0,78) después de la segunda ronda. La proporción de respuestas correctas fue significativamente mayor después de navegar por la WebQuest (valor p <0,001), aumentando del 31,63% en la prueba previa al 87,76% en el post-test.

Conclusión: Los contenidos de la WebQuest y del Instrumento de Verificación del Conocimiento fueron considerados adecuados por los expertos. La WebQuest demostró ser una herramienta educativa eficaz para ampliar el conocimiento del equipo de enfermería sobre la prevención de incidentes en la administración de medicamentos.

Descriptores: Seguridad del paciente; Educaciónen salud; Errores de Medicación; Enfermería; Tecnología Educacional.

INTRODUCTION

Studies developed on the topic addressed here over the last eight years have shown an increase in incidents related to the medication administration process[1,2]. In the United States of America (USA), failures related to this procedure cause at least one death per day[3]. To address this issue, in 2017, the World Health Organization (WHO) launched the global challenge "Medication Without Harm," with the goal of reducing serious and preventable adverse events resulting from medication errors by 50% in five years[3]. Considering the significant impact and adverse consequences associated with failures in this process, publications[1-5] indicate that this challenge highlights the urgency of interventions and practices to promote safety during medication administration.

In the medication administration process, incidents can occur at different stages, from prescription to administration[1,5]. Therefore, caution is essential throughout its development, especially during the administration phase, considered critical because it represents the last stage before the medication is administered to the patient[2,3,6]. For this reason, it is important to pay extra attention at this stage to ensure the safety and efficacy of the treatment, prevent possible incidents and ensure the quality of patient care[7].

The essential strategy to reduce adverse events is the adoption of what has been conventionally named the nine rights of medication administration: 1 - Right patient; 2 - Right medication; 3 - Right route; 4 - Right time; 5 - Right dose; 6 - Right record; 7 - Right guidance; 8 - Right form and; 9 - Right response[3,6]. Although strict adherence to the principles does not completely eliminate the possibility of errors occurring, the use of the nine rights may contribute to the substantial prevention of these events, resulting in improvements in the safety and quality of care[4,5].

Several strategies, with an emphasis on the nine rights, can be adopted to prevent medication-related incidents: lectures, courses, manuals, clinical simulations and WebQuest (WQ)[8-11]. WQ stands out for stimulating critical and reflective thinking of students/professionals in the construction of knowledge about certain topic[8,12]. It is a guided methodological approach in which participants are guided through a series of online tasks, with the objective of investigating, analyzing and synthesizing information found on the web[8,12-15].

In the health field, WQ consists of an important tool for training professionals[9]. However, searches conducted in the Scielo, Lilacs, BDENF, Web of Science and CINAHL databases, covering the period from 1995 to 2023, in English, Portuguese and Spanish, using the descriptors: "Medication Errors", "Nursing Care", "Nursing Education", "Continuing Education", "Nursing Informatics" and "WebQuest", with their corresponding variations in each language, various combinations between these descriptors sets, using the Boolean operators "AND" and "OR", did not identify any study on safe administration of medications.

WQ in the healthcare field emerges as an effective alternative for the knowledge, understanding and application[9,10,16] of the nine rights by professionals, and can also contribute to the global challenges of health safety[3,6]. Thus, WQ, as an educational strategy, integrates guided research on the internet with structured activities, promoting active learning and the development of critical thinking. Unlike other strategies, WQ guides students through selected resources, avoids

information overload and favors autonomous learning in a supervised digital environment[8,12-15].

Considering the above, the following question arises: Does an educational WQ, created based on the nine rights of medication administration, contribute to the prevention of incidents in the medication administration process? To answer this question, the objective of the present study is to develop an educational WebQuest to prevent incidents related to medication administration.

METHOD

Methodological, descriptive, and technological production study – a WebQuest – developed from January 2022 to January 2023, consisting of two stages: a) construction and b) evaluation.

A WQ includes, in its structure, the following elements: Introduction - contextualizes the task in an intriguing manner, aiming to spark the interest of students; Task - defines the educational objectives, encourages the student/user to research and apply the acquired knowledge in practice; Process - guides the navigation through the online content step by step, ensuring the content of the designated tasks; Resources - presents carefully selected information sources, guides the search for relevant and reliable data; Evaluation - assesses the achievement of the objectives and proposes practical and creative activities to consolidate learning, and; Conclusion - favors learning by offering a synthesis of the explored content[12].

The technology construction phase was structured around the identification of domains for WQ development and the generation of items for the Evaluation Instrument (pre- and post-test). The evaluation phase of the technology was conducted in three stages: Phase 1 - Content Evaluation by Experts; Phase 2 - Review and Reformulation; Phase 3 - Pilot Test.

Technology Construction Stage

This stage aimed to identify the relevant content to be addressed in the WQ and in the Knowledge Verification Instrument, which were used before and after browsing the WQ.

To identify the content, searches were conducted in the Scielo, Lilacs, BDENF, Web of Science and CINAHL databases, covering the period from 1995 to 2023, in English, Portuguese and Spanish. The following descriptors were used: "Medication Errors", "Nursing Care", "Nursing Education", "Continuing Education", "Nursing Informatics" and "WebQuest", with their corresponding variations in each language and various combinations between these sets of descriptors using the Boolean operators "AND" and "OR". No WQ study addressing safe medication administration was identified.

The pedagogical content of the WQ was developed based on documents and protocols from the Ministry of Health (MS) and the National Health Surveillance Agency (*Agência Nacional de Vigilância Sanitária* - ANVISA)[6], related to safe medication administration, with emphasis on: medication administration protocols; risk factors associated with errors in administration; educational technologies for incident prevention; training methods for healthcare professionals; and; innovative strategies to improve medication administration safety. These topics were selected with the aim of providing a comprehensive and in-depth understanding of the content to be addressed in the construction of the WQ.

The construction of the WQ was entirely conducted by the author, using a free platform, without the need for additional design software. All decisions related to the color palette, image selection, and content organization were defined by the author herself, to ensure visual coherence and usability of the tool. The process of creating and adjusting the WQ took a total of two months, including both the initial design and the review and maintenance actions. No other people were involved in the construction of the website, which reinforces the author's autonomy throughout all stages of development.

The information obtained from the literature review and official documents was systematized and organized into the following topics: educational materials, activities and evaluation.

The website structure was developed on the free-access online platform *Wix.com*®. To achieve its educational purpose, when developing the WQ prototype, its program content was organized into a structure with a tab/page format consisting of Presentation, Introduction, Task, Process, Resources, Evaluation, Conclusion and Credits. Additionally, the graphic design was created and images from free sources such as Freepik®; Flaticon®; Canva®; Pngwing®; e Pexels® were inserted.

The Presentation tab has a welcome text, a paragraph referring to the WQ as an educational strategy, the target audience, a link directing the participant to the Informed Consent Form (ICF) and another link to Introduction of the content. At the end of the page, there is an image of the authors who developed the WQ and the information about the corresponding researcher.

The Introduction tab has information regarding the safe medication administration, an invitation for the participant to reflect on medication errors and a link to direct to the pre-test, the purpose of which is to assess initial knowledge. Completion of this instrument is mandatory to advance to the next pages.

The Task tab has an explanatory text on how to perform the activity, the purpose of the WQ and references/literature for research. The Process tab contains an explanatory statement on what should be done in this stage and an invitation for the participant to begin studying the topic.

The WQ home page is in the Resources tab, where all the content and documents are located: an infographic, nine images with explanations and documents with links in the "learn more" option. Among these documents, three MS Protocols, three scientific articles/publications and a bulletin on the prevention of prescription errors published by the Institute for Safe Medication Practices (*Instituto para Práticas Seguras no Uso de Medicamentos* - ISMP) stand out).

The Evaluation tab includes a link to access the Knowledge Verification Instrument available on Google Forms®. The Conclusion tab has two short texts: one thanking the participant and another highlighting the purpose of the educational strategy in the context of the nine rights of medication administration. Finally, the Credits tab has the bibliographic references that supported the development of the WQ and, once again, the contact details of the main author.

The link https://wqmedicacaosegura.wixsite.com/wqmedicacaosegura presents the structure of the WQ. Each tab/page contains a link at the end that directs the participant to the next tab.

The Knowledge Verification Instrument - used in the pre- and post-test - was also evaluated by experts and was developed based on the MS protocols[7]. Consisting of 14 questions related to safe practices, this instrument focuses on the nine rights of medication administration. The answers are presented on a five-point Likert scale. It is worth noting that the instrument used in the pre- and post-test is the same, and the only change was in the order/sequence of the questions.

The WQ evaluation instrument, as a learning method, consists of six items for the analysis of technical aspects and seven for pedagogical aspects. The response options are: Adequate (A), Partially adequate (PA) or Not adequate (NA).

Technology Evaluation Stage

Phase 1 - Content Evaluation by Experts

The content evaluation of the WQ and the Knowledge Verification Instrument was conducted by a committee of experts who analyzed all the material and indicated possible exclusions and/or inclusions based on the study objective.

To be part of the committee of experts, the following criteria were established: being a nurse, or a nursing undergraduate professor, with experience/work in the areas of patient safety or medication administration or educational technologies in health or instrument evaluation.

Potential participants were located through the Lattes platform and selected according to the area of interest (patient safety in medication administration and/or educational technologies in health) and the score obtained in the following criteria[9]: Doctoral degree (in the health field) = 4 points; Thesis in the area of interest = 2 points; Master's degree (in the health filed) = 3 points; Dissertation in the area of interest = 2 points; Article addressing the area of interest, published in an indexed journal = 1 point; Professional practice (clinical, teaching or research) of at least two years in the area of interest = 2 points; Being a specialist in the area of interest = 2 points. All those who obtained a minimum score of five points were invited to participate in the content evaluation process.

The invitation to participate in the evaluation process was sent via email, which included the WQ proposal, information about the study objectives and the authors' credentials. At the end, a link was provided that resented two options: one to accept, and another to decline participation in the study. Upon accepting, the participant had to click on another link to access the Informed Consent Form (ICF). After reading this document and

expressing willingness to participate in the research by clicking on the "YES" option, the participant received information regarding the next steps and the link to access the WQ, the WQ Item Evaluation Questionnaire and the Knowledge Verification Instrument. A maximum period of 15 days was also set for the return of completed instruments.

A total of 76 emails were sent, and 20 experts responded. Of these, two did not accept to participate, and of the 18 who accepted, 15 completed the process, responding to all instruments.

Two instruments were used to evaluate the WQ. The first, called the "Content Validity Questionnaire for Experts (WebQuest)"[9], was adapted by the authors of this study by changing the focus of the instrument's questions from organ donation to safe medication administration. It consists of two parts. The first characterized the participant: age, time since graduation, degree, nursing expertise – specializations, titles and publications. And the second addressed questions about technical and pedagogical aspects of the WQ.

The technical aspects refer to the usability, functionality and organization of the WQ, including ease of navigation, clarity of information and suitability of digital tools. The pedagogical aspects assessed the educational quality of the WQ, considering the coherence of the content with the proposed objectives, the ability to promote reflection and meaningful learning, and the alignment with effective teaching methodologies.

The second instrument, also adapted by the authors by changing the focus of the instrument's questions, has questions to assess the content of the Knowledge Verification Instrument[9]. Each item was assessed in terms of content, clarity, objectivity, comprehensiveness, wording and didactic aspects, with the following response options (-1) not adequate; (0) partially adequate; and (1) adequate. If rated as 0 or -1, the authors were asked to provide comments, justifications and/or suggestions for improvement.

Phase 2 - Review and Reformulation

In the evaluation of the 15 experts, the WQ was considered validated in the first round, since, in all aspects evaluated, it achieved a CVR value much higher than that established, and no adjustments were necessary. The Knowledge Verification Instrument was only considered validated by the experts in the second round.

The first version of the Knowledge Verification Instrument had 12 questions, and, after adjustments suggested by the experts, two more questions related to adverse drug events were included. The first version was evaluated by 15 experts, the second by nine. The inclusion of the new questions only impacted on the CVR index, as the cutoff point is determined by the number of participants. The greater the number of participants, the lower the cutoff index, since the objective is to verify whether the content is understandable to the heterogeneous population, reducing potential biases[17-19].

Phase 3 - Pilot test

To evaluate the WQ's capacity to retain knowledge and to assess how appropriate its content and the Knowledge Verification Instrument were for the target audience, a pilot test was conducted in January 2024 with the nursing team of a private general hospital in a city in the northwest of the state of Paraná. It is a small hospital with 85 beds and a nursing team consisting of 86 nursing technicians and 37 nurses.

After authorization from the institution's management to conduct the study, a meeting was held with the Supervisors and Coordinators of the sectors to present the research project, clarify the type of participation required and schedule the days and times for data collection.

Participants were selected by convenience, according to the following criteria: being a nurse or nursing technician, with at least three months of experience in the institution and directly involved in administration of medications to patients. Professionals on leave for any reason or those on vacation during the data collection period were not included.

A total of 35 nursing technicians and 20 nurses met the pre-established criteria. However, four were excluded for not completing the questionnaires and 16 did not agree to participate in the study. The sample consisted of 23 nursing technicians and 12 nurses.

The participants were approached in person by the main researcher and invited to participate in the study. After verbally expressing their agreement, they were instructed to read and digitally sign the ICF, which was incorporated into the Google Forms®. platform. A copy of this signed document was sent to the participant and the researcher via email.

Participation took place in a private room at the institution, with two notebooks with internet available. The researcher visited the institution every day for a week, staying there in the morning and afternoon and at night until 11:30 PM to provide guidance and support for data collection, clarifying doubts and assisting with technical issues related to system navigation.

The professionals' participation was individualized and occurred during their work shift, but if there were any problems, they could return to their units when requested. In these cases, or in the event of any difficulties, the participants had two opportunities to complete the WQ evaluation and fill out the instruments in the following shifts. The time taken to navigate through the WQ and fill out the instruments varied between 20 and 40 minutes. Those who did not complete the form after three attempts were excluded from the study.

It is important to note that the system was configured to require mandatory answers to all questions. Therefore, incomplete forms with unanswered questions could not be finalized or submitted for analysis.

The data were entered into a Microsof Excel® spreadsheet transferred and analyzed in the Statistica Software® version 13. Content Validity Ratio (CVR) was used to assess the content validity of the WQ and the Knowledge Verification Instrument. This index allows an objective assessment of the relevance of each item and indicates whether it is appropriate to measure the desired construct[17].

The determination of the content validity evidence for each item attribute considered a CVR > 0.600 for the first round and CVR > 0.778 for the second round. It is worth noting that the critical value of the CVR is determined according to the number of participating experts[18] , and the calculation is performed with the following formula:

$$CVR = \frac{n_e - \frac{n}{2}}{\frac{n}{2}}$$

Where "n_e" refers to the number of items considered essential (+1), and "N" refers to the number of experts who participated in the validation process.

For the comparative analysis of pre- and post-pilot test knowledge retention, the Mann-Whitney U test was used, with the pre- and post-intervention evaluation scores (WQ browsing) treated as independent variables. Finally, to evaluate the performance of the participants regarding each question of the instrument, the McNemar test was performed to compare the proportions of correct and incorrect answers obtained by the dependent samples (group of professionals before and after browsing WebQuest). The significance level of 5% was adopted for the analysis.

The study was conducted in compliance with the current ethical guidelines and the study was approved by the Permanent Ethics Committee for Research Involving Human Beings of the institution (Opinion No. 5,989,956).

RESULTS

The final version of the WQ was developed and is available for access at the URL https://wqmedicacaosegura.wixsite.com/wqmedicacaosegura.

The 15 experts who participated in the content evaluation stage were all female, with an average time since graduation of 19 years; four (26.7%) of them had a master's degree and 11 (73.3%) held a doctoral degree.

Among the 35 nursing professionals who participated in the pilot test, 25 (71.4%) were female; 25 (71.4%) were 40 years of age or older; 23 (65.7%) were nursing technicians, and 18 (51.4%) worked in Intensive Care Units (ICU). The length of professional experience was approximately five years.

Table 1 presents the content evaluation of the WQ, showing that all items achieved CVR > 0.600.

Regarding the content evaluation of the Knowledge Verification Instrument, during the first round, partially adequate CVR indexes were observed in the items related to "clarity and objectivity" and "didactically appropriate questions". The experts who participated in this process suggested small changes to the instrument: adding two questions and reformulating the wording, regarding clarity, objectivity and didactics, in response to the partially adequate CVR indexes identified. As can be observed in Table 2, in the second round of evaluation, favorable CVR indexes were evidenced in all items.

Table 3 presents the evaluation results of the WQ by nursing professionals, showing that all items were considered adequate.

Table 1 – Content evaluation of the WebQuest by experts (N=15). Single round. Maringá, PR, Brazil, 2023.

Items	A*	PA†	%	CVR‡
Technical aspects				
Ease of accessing pages in the educational technology resource.	15	-	100.0	1.00
Ease of page navigation, access, links, and button functionality.	14	1	86.7	0.87
Visual aspects and screen layout.	14	1	86.7	0.87
Choice of colors and contrast between them.	14	1	86.7	0.87
Font size and type.	14	1	86.7	0.87
Coherence of figures.	15	-	100.0	1.00
Pedagogical aspects				
Content is relevant and appropriate for training.	15	-	100.0	1.00
Achievement of proposed objectives.	15	-	100.0	1.00
Texts are current and consistent with the topic.	15	-	100.0	1.00
Writing is understandable to the student/professional.	15	-	100.0	1.00
Relevant links for access.	15	-	100.0	1.00
Questions are appropriate to the content provided.	15	-	100.0	1.00
Content meets the learning needs of the target audience.	15	-	100.0	1.00

Source: Research data, 2023.
- Values equal to zero not resulting from rounding
*A = Adequate; †PA = Partially adequate; ‡CVR = Content Validity Ratio

Table 2 – Content Evaluation of the Knowledge Verification Instrument by experts. First round (N=15) and second round (N=9). Maringá, PR, Brazil, 2023.

Questions	1st Round					2nd Round			
	A*	PA†	NA‡	%	CVR§	A*	NA‡	%	CVR§
The content of the questions reflects the necessary items for evaluating nursing academic knowledge on the nine rights of medication administration.	15	-	-	100	1.00	9	-	100	1.00
The questions demonstrate clarity and objectivity.	9	6	-	48.6	0.20	9	-	100	1.00
Need some grammatical revision or correction.	13	2	-	75.2	0.73	9	-	100	1.00

Table 2 – Cont.

Questions	1st Round					2nd Round			
	A*	PA†	NA‡	%	CVR§	A*	NA‡	%	CVR§
The questions align with the WebQuest content.	13	2	-	75.2	0.73	9	-	100	1.00
The writing style is appropriate for the level of professionals (nurses and nursing technicians).	14	1	-	86.7	0.87	9	-	100	1.00
The questions are didactically appropriate..	12	2	1	63.8	0.60	8	1	77.8	0.78

Source: Research data, 2023.
- Values equal to zero not resulting from rounding
*A = Adequate; †PA = Partially adequate (no citation in the 2nd round); ‡NA = Not adequate; §CVR = Content Validity Ratio

Table 3 - Pilot test - evaluation of the WebQuest by nursing professionals (N=35). Maringá, PR, Brazil, 2023.

Items	A*	PA†	%	CVR‡
Technical aspects				
Ease of accessing pages in the educational technology resource.	34	1	97.1	0.94
Ease of page navigation, access, links, and button functionality.	35	-	100.0	1.00
Visual aspects and screen layout.	35	-	100.0	1.00
Choice of colors and contrast between them.	34	1	97.1	0.94
Font size and type.	35	-	100.0	1.00
Coherence of figures.	35	-	100.0	1.00
Pedagogical aspects				
Content is relevant and appropriate for training.	35	-	100.0	1.00
Achievement of proposed objectives.	35	-	100.0	1.00
Texts are current and consistent with the topic.	35	-	100.0	1.00
Writing is understandable to the student/professional.	34	1	97.1	0.94
Relevant links for access.	34	1	97.1	0.94
Questions are appropriate to the content provided.	35	-	100.0	1.00
Content meets the learning needs of the target audience.	35	-	100.0	1.00

Source: Research data, 2023.
- Values equal to zero not resulting from rounding
*A = Adequate; †PA = Partially adequate; ‡CVR = Content Validity Ratio

Nursing professionals also rated all items of the Knowledge Verification Instrument as adequate (Table 4).

No adjustments were necessary after the pilot test for either the WQ or the Knowledge Verification Instrument. In the final evaluation, favorable CVR indexes were identified for both tools and they had validated content.

Regarding the pilot test, the responses to the Knowledge Verification Instrument were analyzed, considering the number of correct answers per question before and after browsing the WQ. When comparing the scores obtained at both times, the overall p-value was <0.001, with a mean score of 7.64 and 21.3 and a sum of scores of 107.00 and 299.00 respectively in the pre- and post-browsing moments.

Table 5 shows the number of correct answers for each of the instrument's questions before and after browsing the WQ. The average correct response rate in the pre-test was 31.6%, with the highest proportions in questions 13, 11, and 10, and the lowest in questions 12, 9, and 8. In the post-test, the overall average number of correct answers was much higher - 87.8%. It is worth noting that in the post-test, the proportion of correct answers was only not significantly higher in four questions, demonstrating that browsing the WebQuest favors knowledge retention.

It is noteworthy that specific WQ tabs presented a link to access the Knowledge Verification Instrument, in its final version, on Google Drive® (https://forms.gle/e5vA6CPEHQinYZCJ7).

Table 4 - Pilot test – evaluation of the Knowledge Verification Instrument by nursing professionals (N=35). Maringá, PR, Brazil, 2023.

Items	A*	PA†	%	CVR‡
The content of the questions is appropriate to assess the knowledge of nursing professionals about the nine rights of medication administration.	35	-	100.0	1.00
The questions demonstrate clarity and objectivity.	32	3	91.4	0.83
The questions are grammatically correct.	35	-	100.0	1.00
The questions are adequate for the content covered in the WebQuest.	35	-	100.0	1.00
The writing style is compatible with the level of the professionals (nurses and nursing technicians).	34	1	97.1	0.94
The questions are didactically appropriate.	35	-	100.0	1.00

Source: Research data, 2023.
- Values equal to zero not resulting from rounding
*A = Adequate; †PA = Partially adequate; ‡CVR = Content Validity Ratio

Table 5 – Responses to the Knowledge Verification Instrument by nursing professionals before and after browsing the WebQuest (N=35). Maringá, PR, Brazil, 2023.

Questions*	Pre-Test		Post-Test		
	Correct (N)	%	Correct (N)	%	p-value**
1	15	42.9	34	97.1	<0.001
2	11	31.4	34	97.1	<0.001
3	13	37.1	35	100.0	-
4	6	17.1	35	100.0	-
5	6	17.1	35	100.0	-
6	10	28.6	33	94.3	<0.001
7	11	31.4	25	71.4	0.004
8	3	8.6	25	71.4	<0.001
9	3	8.6	30	85.7	<0.001
10	19	54.3	31	88.6	<0.001
11	19	54.3	31	88.6	0.008
12	1	2.9	25	71.4	<0.001
13	25	71.4	32	91.4	0.065
14	13	37.1	25	71.4	0.004

Source: Research data, 2023.
*Questions from the Knowledge Verification Instrument
**McNemar's test for comparing proportions of dependent samples.
-Test result not generated due to only correct answers in the post-test.

DISCUSSION

In the content evaluation of the WQ, the Technical and Pedagogical Aspects were analyzed, which obtained a CVR > 0.600, indicating adequate agreement between the evaluators regarding the relevance and pertinence of the items evaluated. These results suggest that the WQ is a valid tool for evaluation in both its technical and pedagogical aspects.

Evaluating the technical aspects of the WQ is important to obtain information about its ease of navigation, functionality, usability and compatibility. And regarding the pedagogical aspects, the evaluation seeks to know whether the proposed learning objectives can be achieved or not[9,20,21].

The data from this study align with other studies conducted in Brazil, in which one validated a WQ focusing on organ donation, used the Content Validation Index (CVI) and obtained an overall index of 100%, that is, excellent[9]. Another study also applied the CVI and obtained an excellent result when validating a WQ focusing on the approach to death communication for children[21].

The robustness of a WQ is not limited only to practical application, but also to the systematic observation of its properties[8-9,12]. In this study, the evidence of validity of the WQ and the Knowledge Verification Instrument was examined through the CVR analysis, a statistical technique particularly recommended for its sophistication in quantitatively assessing content validity[22]. No WQ was found in the literature addressing errors, or rather, the "nine rights" of medication administration.

The evaluation of pedagogical, technical and content aspects of the WQ by nursing professionals confirmed its ease of understanding, relevance and importance, with satisfactory percentages and much higher than those established (CVR > 0.600), indicating that this resource can be used as an innovative technological teaching strategy to verify prior and acquired knowledge by nursing professionals.

The fact that digital technologies constitute contemporary tools aligned with active approaches, in which the student is placed at the center of the learning process[8,12-13,15], and in scenarios in which professors face high demand, it reinforces the importance and urgency of using attractive resources that favor the teaching-learning process[8,10,23-25].

Regarding the content evaluation of the Knowledge Verification Instrument, in its first version the CVR recorded partially adequate indices in items 2 and 6, with experts mentioning the need for improvement. The recommendations presented were fully incorporated, resulting in a higher CVR index in the second version of the instrument (final version), and it was therefore considered suitable for assessing the professionals' both prior and acquired knowledge.

In the pilot test, nursing professionals validated the Technical and Pedagogical Aspects of the WQ and the items of the Knowledge Verification Instrument, as the CVR indexes were considered adequate, requiring no adjustments. This result indicates that both can be applied to the target population, as there is strong agreement among professionals regarding the relevance and pertinence of the items.

Conducting pilot tests plays a fundamental role in the development of educational strategies, providing a preliminary assessment of the effectiveness, validity and reliability of the elements developed[22,26]. In this context, other studies[27-28] are in line with this statement and highlight the importance of pilot studies to identify possible limitations/inconsistencies that can be adjusted before the instrument before a large-scale application.

Within the context of continuing education, pilot tests also allow to assess the effectiveness of teaching methods or pedagogical interventions before their implementation[27,29]. They are, therefore, crucial for improving pedagogical strategies[5,10-11,22,27] enabling adjustments to teaching approaches based on initial participant feedback and the adequacy of educational materials[11,22, 26-27].

Thus conducting pilot tests not only improves methodological quality, but also reflects an ethical commitment to maximizing benefits and minimizing errors. This can undoubtedly be considered a critical but necessary phase in the development of educational strategies such as the WQ addressed in this study.

The results of the analysis of the responses to the WQ Knowledge Verification Instrument, used to measure prior and acquired knowledge by nursing professionals, were satisfactory, considering that an average correct response rate of 87.76% was observed in the second moment. This correct response rate suggests that the WQ contributed to the advancement of participants' knowledge, demonstrating its usefulness as an educational tool in the context evaluated.

Studies that evaluated the knowledge acquired after the application of the WQ found an increase in the number of correct responses and stated that there was an improvement in participants' level of knowledge[9,10,14,16]. Another study that investigated the use of educational technology in the learning process found an average increase of 3.5 points in the participants' level of knowledge, with significance between the scores obtained in the pre-test and post-test ($p<0.001$)[30].

n the healthcare context, the development and implementation of teaching-learning strategies are crucial to avoid medication administration errors[4,6-,7,25]. Considering the growing use of digital technologies in this area, the literature[9,10,12-14] highlights the significant contribution of this resource to the development and updating of essential professional skills, and this can be observed in the pilot test of the WQ of the present study, since the participants in the post-test showed a significant increase in the percentage of correct answers and, possibly, n improvement in their knowledge of the subject.

As limitations of this study, stands out the exclusive participation of nursing professionals linked to a single institution; the sample of experts consulted may not adequately reflect the diversity of opinions and knowledge in the field, which suggests the need for a broader and more representative sample in future studies. Furthermore, although the increase in immediate knowledge observed is promising, it is essential to investigate whether this improvement is sustained over time and whether it results in more positive clinical outcomes. Therefore, future research should focus on evaluating the durability of the observed effects and their clinical relevance.

It is recommended that future studies include diverse and representative samples to validate and extend the conclusions of this research. Furthermore, a more comprehensive assessment of the applicability of the WQ in different professional contexts, which directly or indirectly participates in the medication administration process, should also be considered.

CONCLUSION

The WebQuest and the Knowledge Verification Instrument had their contents considered appropriate by the Expert Committee (CVR > 0.94 and CVR > 0.83 respectively), which was ratified by the nursing professionals. In the knowledge verification, the proportion of correct answers was significantly higher after browsing the WebQuest (p-value <0.001), increasing from 31.63% in the pre-test to 87.76% in the post-test.

The developed WebQuest proved to be effective in improving professionals' knowledge about the nine rights of medication administration. Therefore, it constitutes a strategy that can contribute to preventing incidents in the medication administration process.

Within the scope of nursing education, this study shows that the use of the WebQuest as an educational resource can represent an advance for education. This is because this approach enables the integration of technology into the teaching process, allowing for dynamic educational experiences that are adaptable to current needs. It is therefore suggested the use by nursing professionals working in different contexts and also by undergraduate and technical-level students in the nursing field, aiming to strengthen the positive evidence of this educational technology.

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Data and material availability

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