ORIGINALES

Validation of the content of a serious game to support patient safety teaching

Validação de conteúdo de um serious game para apoio ao ensino da segurança do paciente

Validación de contenido de un *serious game* para apoyo a la enseñanza de la seguridad del paciente

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ABSTRACT:
Objective: To validate the content of the prototype of a serious game targeted at teaching patient safety in nursing.
Method: Methodological study with a quantitative approach, according to a psychometric reference. Validation procedures were carried out in November 2018, in two Delphi validations. The items that reached content validation coefficient of 0.80, or agreement equal or above 80%, were considered valid.
Results: 10 judges participated in the first Delphi round, while 6 participated in the second. At the end of the second Delphi round, all items analyzed reached values above 0.80 and 80%.
Conclusion: The content developed for the serious game is valid to promote the teaching of patient safety.

Keywords: Educational Technology; Validation Studies; Nursing; Nursing Education; Patient Safety.

RESUMO:
Objetivo: Validar o conteúdo do protótipo do *Serious game* para o ensino da segurança do paciente na enfermagem.
Método: Estudo metodológico de abordagem quantitativa conforme referencial psicométrico. Os procedimentos de validação foram realizados de setembro a novembro de 2018, a partir de duas conferências Delphi. Considerou-se validos os itens que atingiram coeficiente de validação de conteúdo igual ou maior a 0,80 e concordância igual ou maior a 80%.
Resultados: Na primeira rodada Delphi participaram 10 juízes e na segunda seis. Ao final da segunda etapa Delphi o conteúdo analisado atingiu em todos os itens valores superiores a 0,80 e 80%.

Conclusão: Evidenciou-se que o conteúdo desenvolvido para o *serious game* é valido para promoção do ensino da segurança do paciente.

Palavras-chave: Tecnologia Educacional; Estudos de validação; Enfermagem; Educação em Enfermagem; Segurança do Paciente.

RESUMEN:
Objetivo: Validar el contenido del prototipo del *Serious game* dirigido a la enseñanza de la seguridad del paciente en enfermería.
Método: Estudio metodológico de abordaje cuantitativo conforme referencial psicométrico. Los procedimientos de validación fueron realizados de septiembre a noviembre de 2018, a partir de dos conferencias Delphi. Se consideraron válidos los ítems que alcanzaron un coeficiente de validación de contenido de 0,80 y concordancia igual o superior al 80%.
Resultados: 10 jueces participaron en la primera ronda Delphi, mientras que 6 participaron en la segunda. Al final de la segunda ronda Delphi, todos los ítems analizados alcanzaron valores superiores a 0,80 y 80%.
Conclusión: El contenido desarrollado para el juego serio es válido para promover la enseñanza de la seguridad del paciente.

Palabras clave: Tecnología Educativa; Estudios de Validación; Enfermería; Educación en Enfermería; Seguridad del paciente.

INTRODUCTION

The insertion of digital technologies in the many aspects of society is now an undeniable reality, and represents a cultural shift into the so-called cyberculture, a state in which human beings use digital tools to support their relations and daily life activities [1,2].

Among these practices, the teaching-learning process stands out, as it implies social, cultural, and educational changes to support learning, in such a way that the insertion of digital technologies in this environment is indissociable from a significant learning[2,3].

This is mainly associated to the new student profile, referred to as 3.0, which refers to students who were born and, therefore, developed in the age of the Internet, and thus, their teaching-learning process is strengthened through the use of technological resources[4].

Furthermore, there are different digital tools that can support teaching. Among them, the serious games stand out, which are games idealized and built with the learning process in mind, which use gamification, immersion, and simulation to strengthen this process [5].

At first, these games were developed to train professionals in the work environment, but as their efficacy was proven, their use was expanded to the field of school and university education. Their relevance was demonstrated by a study [6] carried out in Portugal, which showed improvement in the learning and satisfaction of the students after the use of the serious game.

In the meantime, it stands out how important these resources are to teach the themes of the field of health, such as Patient Safety (PS), since this is a cross-sectional theme in the process of formation and in professional practice, being of higher complexity for learning [7,8].

Furthermore, it stands out that teaching PS is to teach health professionals to act safely and, as a consequence, leads to the reduction of adverse effects to patients' health. As a result, in 2011 the World Health Organization (WHO) released the Multi-professional Patient Safety Curriculum Guide, a guideline about content and strategies to aid in the process of teaching-learning about the theme [8,9].

Considering the above, using the serious game to support the teaching of PS is a strategy that provides the student with a safe learning environment, in addition to immersion in the learning process, interactivity, entertainment, also being in accordance with the other current demands of the teaching process [7,8].

Furthermore, it stands out that, in addition to the construction of the serious game, it needs to be based on scientific evidence and validated by experts in the field. As a result, the serious game then built is determined to be valid and is capable of giving support to the teaching process [10].

As a result, the following guiding question is brought forth: is the content elaborated for the serious game valid to support the teaching of PS in nursing? The research aimed to validate the content of the prototype of a serious game targeted at teaching patient safety in nursing.

METHOD

This is a methodological, quantitative study, developed according to psychometric references [11]. This type of research enables the validation of content, instruments, protocols, and techniques by a group of specialists that will determine whether the material validated is adequate [11,12].

The validation process was carried out from September to November 2018 using the Delphi technique, which consists in in sending and/or presenting the content to be validated to a group of judges who are specialists in the field, who will determine whether the material is valid or not for its objective. It stands out that the Delphi technique takes as many rounds as needed to reach the level of consensus needed [13].

With regard to the selection of the judges, it was carried out through the Lattes platform, using, as a search strategy: Search mode [subject (title or keyword of the production)] - Patient Safety; in the bases - PhDs and other researchers; Professional practice: Great field - Health Sciences/ Field - Nursing. The evaluators were selected from the analysis of their curriculum according to preestablished criteria [14].

The criteria to select the evaluators were adapted from the items formulated by Fehring in 1994, among which, were considered: being at least an MS, conducting research in the field of PS, having publications about PS, experience as a professor in the field of PS or nursing, and being a specialist in PS.

At first, 50 evaluators were selected, considering the minimal number of evaluators necessary to validate the content according to the references chosen and the losses resulting from the Delphi rounds [11,15]. After selection, the experts were invited via email to participate in the study, and presented to the project and its objectives.

Ten evaluators responded to the first invitation, stating that they accepted participating in the research. They were sent Free and Informed Consent Forms (FICFs) and a link to access Google Forms, which contained the material for evaluation.

The form, built using Google Forms, presented instructions to fill the questionnaire in, sociodemographic information, the opening screen of the serious game based on the PS protocols (correct patient identification; safe surgery; safe prescription, use, and administration of medications; prevention of pressure lesions; prevention of falls; hand hygiene).

The judges evaluated the content using a Likert scale which varied from 1 to 3 (inadequate, partially adequate, and adequate), in which the indicators were the 12 criteria adapted from the references used[11]. Table 1 presents the criteria used for the validation.

Table 1 - Adapted demands for content adequacy, Natal/RN, 2022.

Criterion	Requirements
Behavior	The script has a clear and objective order.
Objectivity	The script allows the objective proposed to be reached.
Simplicity	The dialog from the script expresses a single idea and allows adequate understanding.
Clarity	The content of the script is clear and unambiguous.
Relevance	The script is presented in a relevant way and attends to the demands of teaching.
Precision	Each dialog and action of the script is distinct and cannot be confused for another.
Variety	The language is varied and allows for interactivity with the user.
Modality	The vocabulary is adequate to the target audience, generating no ambiguity.
Vernacular	The vocabulary used is in accordance with the theme addressed.
Credibility	The construction of the script is in accordance with the profile of the target audience.
Amplitude	The content of the script is updated and deals in-depth with the theme and the target audience.
Balance	The sequence of the actions in the script is logical and coherent.

Data analysis took place using simple descriptive statistics for the sociodemographic data of the evaluators. For the validation process, the content validity index (CVI) was calculated according to the formula established by the references used and to the level of agreement [11,16]. This research considered that CVI > 0.8 and a level of agreement above 80% were valid.

It stands out that this study is in accordance with ethical precepts established by Resolution No. 466/2012, from December 12, 2012, from the National Council of Health, and its approval was provided by a legal opinion from the research ethics

committee from the Universidade Federal do Rio Grande do Norte, No. 2.455.166, CAAE: 80922917.0.0000.5537, on December 22, 2017.

RESULTS

Content validation was carried out in two Delphi rounds. The first included 10 evaluators, while Delphi II counted on 6. Table 2 shows the sociodemographic characteristics of the experts, in each stage of the Delphi verification.

Table 2 - Sociodemographic characteristics of the evaluators in the Delphi I and Delphi II rounds, Natal/RN, 2022.

Sociodemographic characteristics	Delphi I (N = 10)	Delphi II (N= 6)
Sex		
Female	8 (80%)	5 (83.3%)
Male	2 (20%)	1 (16.7%)
Age		
35 to 40 years old	7 (70%)	4 (66.6%)
46 to 50 years old	1 (10%)	0 (0%)
Above 50 years old	2 (20%)	2 (33.4%)
Field of practice		
Teaching	8 (80%)	4 (66.6%)
Health care	1 (10%)	1 (16.7%)
Teaching and health care	1 (10%)	1 (16.7%)
Time working with the theme of PS		
5 to 10 years	8 (80%)	4 (66.6%)
10 to 15 years	1 (10%)	1 (16.7%)
More than 15 years	1 (10%)	1 (16.7%)

Regarding the content validation process of Delphi I, the evaluation of the judges had levels of agreement above 80%. The initial screen and the scripts 1, 2, 5, and 6 had the best levels of agreement, reaching 90%, while the scripts 3 and 4 had 80%. Therefore, all items evaluated are in accordance with the criteria selected.

Regarding the CVI values found by Delphi I, it was found that only scripts 1 and 3 presented items with values below 0.80, indicating the need for a second Delphi conference after adjustments to identify how adequate the proposed content was, as indicated in Table 3.

Table 3 - CVI values after Delphi I, Natal/RN, 2022.

Adapted Pasquali Criteria	Initial screen	Script 1	Script 2	Script 3	Script 4	Script 5	Script 6
Behavior	0.96	0.89	0.93	0.93	0.93	0.96	0.96
Objectivity	0.86	0.89	0.93	0.86	0.93	0.93	0.93
Simplicity	0.89	0.89	0.96	0.89	0.89	0.96	0.93
Clarity	0.89	0.79	0.89	0.89	0.86	0.89	0.93
Relevance	0.96	0.83	0.86	0.83	0.83	0.93	0.96
Precision	0.96	0.89	0.86	0.89	0.93	0.93	0.93
Variety	0.83	0.93	0.96	0.93	0.93	0.96	0.96
Modality	0.89	0.89	0.96	0.93	0.89	0.93	0.96
Vernacular	0.96	0.96	0.93	0.89	0.89	0.96	0.89
Credibility	0.86	0.96	0.89	0.89	0.86	0.93	0.96
Amplitude	0.86	0.89	0.86	0.79	0.83	0.83	0.89
Balance	0.96	0.96	0.93	0.89	0.89	0.96	0.96
Total CVI	0.91	0.90	0.91	0.89	0.89	0.93	0.94

After Delphi I, the judges suggested modifications, whose inclusion was evaluated. Pertinent suggestions were included in the content, and suggestions that were not used were sent back to the evaluators with a justification. Table 4 shows the suggestions that were not accepted and the justifications for their refusal.

Table 4 - Evaluator suggestions not included after Delphi I and the reasons for not including them, Natal/RN, 2022.

EVALUATOR SUGGESTIONS	RESPONSES TO THE JUDGES FOR NOT INCLUDING THEM
Language must be closer to the player, even considering they are professionals. At the moment they access the game they will all be considered players, and language must be more informal/less academic.	Despite the gamified approach, the material is educational; therefore, it is pertinent to use language that is in accordance with the target audience.
Regarding the item "CREDIBILITY", I suggest the initial page to call more attention to it, to be more adequate to the target audience.	The image presented to the evaluators refers only to the content that will be part of the opening screen of the serious game. It is not the real screen of the game, which will have images and animations, making it more attractive to the public.
In the item "AMPLITUDE" it would be interesting to present other settings in which the player can reflect on how the patient will be identified. For instant, a patient with no identification.	The serious game being developed can generate other situations. However, at this point, the research aims to validate a single setting, related to international patient safety goals.
Dialog 1: it is not real (the person who	Although that does not happen in most

receives the patient in OR is the nurse, not the physician);	hospitals, it is the recommended standard. Therefore, since the serious game is educational, it must be in accordance with the adequate practices of the profession.
On the item "CLARITY", it would be interesting, instead of just indicating whether the number of instruments and materials is right before and after the procedure, to say how many there were at the beginning, and how many at the end, to enumerate them.	Adding this information is not pertinent, considering that said enumeration is related to the content of surgical instrumentation. To form professionals in the aspects of patient safety, they must understand how necessary it is to verify whether the number of items used in the beginning of the surgery is the same at the end. Therefore, enumerating the items and pointing out which ones were used is not within the scope of the theme determined for the game.
In the item "RELEVANCE", it would be interesting if the player could count the material before and after the surgery. It would also bring more credibility to the target audience and give more amplitude to the game.	This item is not pertinent, since it is not in line with the objective of this serious game, which is teaching patient safety. The insertion of instruments would take a long period of time, considering how many materials are needed to carry out this procedure. It would also be content related to surgical instrumentation, as opposed to patient safety.
I believe that the terms sign in, time out, and sign out, used in some institutions, should be included.	This suggestion was excluded because the game uses as its reference the protocols established by the World Health Organization, aimed at guaranteeing the teaching of the theme in accordance with the premises of this worldwide entity. Furthermore, the use of terms that are specific to some institutions can bring the game further away from the reality of the players, pushing them away from the game, since they may not understand the specific terms used.
Suggestion: in the line of nurse Orem, who says that she may have hurt the patient, because he is diabetic. This is what an incident with damage to the patient would be.	The fact that nurse Orem points out that she may have harmed the patient is related to the concept of near miss, since this type of incident is understood as an event that happened, that is, the serums were in fact exchanged, but it did not affect the patient, since the nurse noticed the mistake before the infusion.

I suggest emphasizing the notification of the event more strongly. How to verify the 9 right answers before preparing/administrating the drug? Maybe these could be put as important elements to be verified/educational activities after the incident.	The nine rights are emphasized, in page 2 of dialog 3, during a decision that the player must make.
In dialog 3, the medication prescribed and presented for the player is the saline. I did not understand how it could be presented as a glucose solution in dialog 4.	The presence of the glucose solution is what represents the occurrence of the near miss. The patient was prescribed saline solution; however, the nurse prepared a glucose serum solution, and only at the moment she is about to start the infusion, she noticed the exchange in the solutions.
Furthermore, the nurse knows everything that should be done to the patient with regard to preventing lesions, and there is no need to ask a physical therapist. She could talk to him about respiratory physical therapy. I believe that this part, as much as there is an attempt to include a multidisciplinary character, could be written differently.	The exchange of knowledge between the professionals aims to call the attention of the students to the importance of looking at the case of the patient from different perspectives, so the insertion of a multiprofesisonal team for planning and executing care to patient strengthens its recovery process.
Also, with regard to the bone prominence, covers to hydrate and protect the skin could be mentioned, and that was not indicated. Prescribing a moisturizer 6x a day, I believe, is not coherent.	In the script, this item is the wrong choice. There are many statements, which the player must select as true or false.
Verify the level of consciousness of the patient.	This is done in dialog 1.
Asking for help to immobilize the patient and bring them to the bed for an evaluation.	This is done in dialog 1.
Strategies: add periodical rounds for patients of moderate and high risk, using JOHNS HOPKINS scales.	The choice for the Morse scale is in accordance with the recommendations from the World Health Organization protocol for fall prevention. Therefore, inserting another scale to this end would not be in accordance with what was suggested by the framework of references.

It would be very interesting if the player could order the stages of hand sanitation, as well as its five moments. To broaden the scope further, surgical cleaning or pre-operative hand preparation could also be considered.	The insertion of surgical content is not an objective of this serious game. However, patient safety is a cross-sectional theme, and the contents supported by the game are expected to reflect directly in all professional actions of the players, so they can become trained to reflect on patient safety in all types of practice.

Regarding the second Delphi conference, there was an agreement of more than 80% among all judges, so that the initial screen and the scripts reached significant agreement levels. Regarding the CVI, it was calculated that all content reached a validation index above 0.80. Table 5 shows the values of CVI.

Table 5 - CVI values after Delphi II, Natal/RN, 2022.

Adapted Pasquali Criteria	Initial screen	Script 1	Script 2	Script 3	Script 4	Script 5	Script 6
Behavior	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Objectivity	0.94	0.99	0.88	0.99	0.99	0.99	0.99
Simplicity	0.99	0.88	0.88	0.88	0.94	0.88	0.99
Clarity	0.99	0.88	0.88	0.88	0.88	0.94	0.99
Relevance	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Precision	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Variety	0.94	0.99	0.99	0.99	0.99	0.99	0.99
Modality	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Vernacular	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Credibility	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Amplitude	0.99	0.99	0.88	0.99	0.99	0.99	0.99
Balance	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Total CVI	0.99	0.98	0.96	0.98	0.98	0.99	0.99

At the end of the Delphi rounds, it was found that the content evaluated reached a level of agreement found to be adequate between the judges in both rounds, and the CVI was considered to be valid after adjustments in Delphi II, with values above 0.80.

DISCUSSION

The evaluators who participated in the content validation are mostly female. This is related to a nursing historic factor, since, in the beginning of the formation of the profession, caring was considered an exclusively feminine trait, associated to maternity, and as a result, only women were accepted [17].

However, as nursing became a science, the stereotype of being an exclusively female profession changed. As a result, there has been, in the last few years, a constant insertion of men, leading to the process of masculinization of the profession [17,18].

Regarding the age group, in the two Delphi validations, there was a predominance of evaluators from 35 to 45 years old. This can indicate that the work experience of the evaluators is significant, considering the Brazilian environment, in which workers tend to start their work life in the formal job market by 24 years old [19].

Therefore, the evaluators who participated in the validation process have a relevant time of experience to evaluate the materials and verify whether its content is valid to promote PS teaching [19].

Regarding the field of action of the judges, it was found that most are professors. This indicates that these evaluators work closely with scientific research, since Brazilian professors from public universities must carry out activities of teaching, extension, and investigation as part of their work [20].

As a result, the presence of evaluators who are experienced with scientific work can aid in the process of content validation, since the fact that they know different types of study methods favors a clearer analysis of the method proposed [20].

It stands out that some evaluators work both in teaching and assistance, which leads to evaluations that bring forth the perspective from the practice of health care. As a result, they can indicate whether the content produced is in accordance with the reality of work, and, as a consequence, whether it can aid in the promotion of the teaching-learning process of PS [21].

Regarding the procedures to verify the content validation, in both Delphi validations the judges agreed significantly with regard to how fitting the content produced was to support the teaching of PS.

Therefore, the material was found to be pertinent for the creation of a serious game that would support teaching PS. Furthermore, the technology proposed is in accordance with the current demands of teaching, since it is characterized as blended learning, that is, a distance teaching that is mediated by technology[22].

Regarding the process of content validation, in the Delphi I verification, only two items did not reach the minimum score to be considered valid. These were regarding the clarity of script 1, and the amplitude of script 3.

The fact that the item clarity was not validated indicates that the content of the script written may have unclear features, which can hinder the adequate understanding of the material, thus compromising the objective of the content created, since it seeks to give support to the teaching of PS [11].

A study[23] carried out in 2017 showed that this is one of the most difficult criteria to reach an adequate value, since it varies with the interpretation of those who wrote it and of those who will use it. For this purpose, clarity demands the use of a language that is accessible, clear, and in common between the researchers and the target audience.

Regarding the second non-validated item, amplitude, it is related to how fitting the content is, that is, how updated, in-depth, and how adequate to its target audience. This element analyzes whether the serious game can respond to the teaching

demands of adequate content, whether it is in accordance with the idealized user and includes updated knowledge about PS [11].

Additionally, at the end of the Delphi validations, both the initial screen and the scripts reached the necessary score, indicating that the material has the potential to aid in the teaching of PS. However, the judges gave suggestions to improve the content of the serious game, which were pondered.

Among the scores reached, items were found to be adequate when they reached scores above 0.80. The clarity criterion stood out in scripts 1, 2, 3, and 4 since it obtained the lowest fitness values, indicating that, according to the evaluators, the language is not entirely clear. However, the way in which it is presented is clear enough to understand the content and favor PS learning [11,23].

Another item whose CVI was below 0.90 was "simplicity", in the scripts 1, 2, and 3. This item indicates that the judges agree that the content built shows a unique idea of the material proposed and does not present doubtful ideas that can hinder learning. Therefore, through the evaluation of simplicity, it can be inferred that the content of the serious game is fit to promote PS teaching [11].

Regarding the amplitude criteria, it shows how relevant the content developed for the serious game is to support the teaching of PS, considering how deep and up-to-date it is [11].

That said, it stands out that the material created achieved, in most cases, CVIs above 0.90, indicating a significant agreement among the evaluators that the serious game has potential to promote PS teaching.

CONCLUSION

The content analysis carried out by the evaluators in Delphi stages showed that the content developed for the serious game is valid to give support to PS teaching.

Its limitations are the procedures of adaptation to psychometric criteria for the analysis of the serious game, since the understanding and interpreting of it by the evaluators can vary, leading to misaligned understandings in the process of validation.

It stands out that the content produced for the serious game is an innovative tool to support the teaching-learning of PS, which is an essential theme to promote a safe and qualified integral health care.

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