

Serious Game Terminologia Secreta (TESE): educational technology applied to the teaching of basic nursing



Serious game Terminologia Secreta (T.E.S.E.): tecnologia educacional aplicada ao ensino de Enfermagem Fundamental

Serious game Terminologia Secreta (T.E.S.E.): tecnología educativa aplicada a la enseñanza primaria de enfermería

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ABSTRACT

Objective: To develop and validate a serious game-type application for nursing students on Fundamental Nursing.

Method: Methodological development research, with a quantitative and descriptive approach. It was conducted in the Midwest region of Brazil, between January 2022 and June 2023, in four phases: development and validation of the internal content of the application; programming software; validation of the application's usability by 11 experts and 33 nursing students, using the System Usability Scale.

Results: The app includes a game with technical terms, player rankings and an online pocket guide. Usability was validated by 11 experts and 33 nursing students using the System Usability Scale. The average scores were 92.5 and 87.5 respectively, classifying the technology as "best imaginable", with high acceptance, integrated functionality and intuitive navigation.

Conclusion: The TESE application demonstrated good usability and high user acceptance, proving to be an important strategy for enhancing the teaching-learning process for nursing students in Fundamental Nursing. The technology developed can contribute to the improvement of interprofessional communication and clinical nursing practice through the standardized mastery of technical terminology.

Descriptors: Educational technology; nursing; Nursing education; Video games; Teaching.

RESUMO

Objetivo: Desenvolver e validar um aplicativo do tipo serious game para estudantes de enfermagem sobre Enfermagem Fundamental.

Método: Pesquisa de desenvolvimento metodológico, com abordagem quantitativa e descritiva. Realizou-se na região Centro-Oeste do Brasil, entre janeiro de 2022 a junho de 2023, em quatro fases: elaboração e validação do conteúdo interno do aplicativo; programação do software; validação da usabilidade do aplicativo por 11 especialistas e 33 estudantes de enfermagem, utilizando-se a *System Usability Scale*.

Resultados: O aplicativo inclui um jogo com termos técnicos, ranking de jogadores e guia de bolso online. A usabilidade foi validada por 11 especialistas e 33 estudantes de enfermagem, utilizando a *System Usability Scale*. As pontuações médias foram 92,5 e 87,5, respectivamente, classificando a tecnologia como "melhor imaginável", com alta aceitação, funcionalidade integrada e navegação intuitiva.

Conclusão: O aplicativo T.E.S.E. apresentou boa usabilidade e elevada aceitação dos usuários, demonstrando ser uma importante estratégia para potencializar o processo de ensino-aprendizagem para estudantes de enfermagem sobre Enfermagem Fundamental. A tecnologia desenvolvida pode contribuir para o aprimoramento da comunicação interprofissional e da prática clínica de enfermagem através do domínio padronizado da terminologia técnica.

Descritores: Tecnologia educacional; Enfermagem; Educação em enfermagem; Jogos de vídeo; Ensino.

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RESUMEN

Objetivo: Desarrollar y validar una aplicación tipo serious game para estudiantes de enfermería sobre Enfermería Fundamental.

Método: Investigación de desarrollo metodológico, con enfoque cuantitativo y descriptivo. Se llevó a cabo en la región centro-oeste de Brasil, entre enero de 2022 y junio de 2023, en cuatro fases: elaboración y validación del contenido interno de la aplicación; programación del software; validación de la usabilidad de la aplicación por parte de 11 especialistas y 33 estudiantes de enfermería, utilizando la Escala de Usabilidad del Sistema.

Resultados: La aplicación incluye un juego con términos técnicos, clasificaciones de jugadores y una guía de bolsillo en línea. La usabilidad fue validada por 11 expertos y 33 estudiantes de enfermería mediante la Escala de Usabilidad del Sistema. Las puntuaciones medias fueron de 92,5 y 87,5 respectivamente, lo que clasifica la tecnología como "la mejor imaginable", con gran aceptación, funcionalidad integrada y navegación intuitiva.

Conclusión: La aplicación T.E.S.E. presentó una buena usabilidad y una alta aceptación por parte de los usuarios, demostrando ser una estrategia importante para potenciar el proceso de enseñanza-aprendizaje de los estudiantes de enfermería sobre Enfermería Fundamental. La tecnología desarrollada puede contribuir a la mejora de la comunicación interprofesional y de la práctica clínica de enfermería a través del dominio estandarizado de la terminología técnica.

Descriptores: Tecnología educativa; Enfermería; Educación en enfermería; Videojuegos; Enseñanza.

■ INTRODUCTION

The educational landscape is constantly transforming, driven by technological advances that have promoted significant changes in various sectors, with particular emphasis on the areas of health and education⁽¹⁾. In this context of digital transformation, mobile learning (mLearning) emerges as an innovative educational modality that uses mobile devices to enhance the results of the teaching-learning process. This technological approach has been systematically employed to complement traditional teaching methods, promoting the sharing of information and knowledge in a dynamic and interactive way⁽²⁾.

The incorporation of interactive educational strategies revolutionizes the learning environment, providing greater flexibility, expanding access to knowledge, and creating more engaging teaching modalities that encourage student autonomy⁽³⁾. Digital tools, such as games, are particularly efficient in engaging the new generation of students and fostering active and participatory learning⁽⁴⁾. The effectiveness of this approach is proven by recent studies in nursing education, where the use of digital educational games led to a statistically relevant development of crucial skills such as critical thinking and clinical decision-making^(5,6).

Alongside the advancement of mobile technologies in education, the adoption of the Serious Games (SG) as innovative tools in nursing education stands out. Developed for educational and simulation purposes, these games can be used on mobile devices, such as

smartphones and tablets, establishing themselves as central resources in health education⁽⁷⁾.

Evidence from systematic review and meta-analysis indicates that the use of digital educational games by nursing students results in statistically significant improvements in knowledge, self-confidence and overall performance compared to traditional teaching methods⁽⁶⁾.

Other studies, including meta-analyses on gamified strategies, show positive impacts on both the acquisition of theoretical knowledge and the development of practical skills in nursing^(8,9). In particular, experimental research conducted with 21 students identified a significant improvement between pre- and post-intervention assessments, with 95% of participants reporting a substantial increase in their mastery of medical terminology after using specific educational technology⁽¹⁰⁾.

The Fundamental Nursing discipline is essential for the development of professional skills, requiring mastery of technical terminology for safe communication⁽¹¹⁾. The use of digital educational technologies, such as SG, facilitates the assimilation of content, standardizes procedures, encourages student autonomy and offers a safe environment for practice⁽¹²⁾. Evidence indicates that these methodologies significantly improve students' knowledge, self-confidence and performance compared to traditional methods^(6,9,11).

Despite international recognition of the potential of SG in health education and the trend of students progressively taking the lead in their own learning process⁽¹³⁾, there is a scarcity of studies in Brazil focused on the development and validation of digital technologies

for teaching Fundamental Nursing, which highlights a gap in national scientific production⁽⁶⁾. The current context demands rigorous research that supports the use of innovative resources, strengthening nursing science in Brazil.

Given this scenario, this investigation aims to answer the following question: how does the methodological process of developing and validating a software application for teaching Fundamental Nursing occur? Thus, the general objective was to develop and validate such an application for nursing students on Fundamental Nursing.

■ METHOD

Methodological study⁽¹⁴⁾ with a quantitative and descriptive approach carried out in the Central-West region of Brazil from January 2022 to June 2023. The article was written based on the guidelines of the instrument Standards for Quality Improvement Reporting for Excellence (SQUIRE -EDU)⁽¹⁵⁾.

The study was based on the methodological protocol of Contextualized Instructional Design (DIC)⁽¹⁶⁾, adapted to the Brazilian context of nursing education, incorporating current recommendations for the development of SG and educational applications⁽¹⁹⁾. The four phases of the study were: 1) elaboration and validation of the theoretical content; 2) programming and development of the software; 3) validation of usability by clinical experts and 4) validation of usability with undergraduate nursing students.

Development and validation of theoretical content.

For phase 1, the construction of the concepts was based on a systematic literature review conducted between January and March 2022, following a rigorous review protocol. The search was conducted in the PubMed /MEDLINE, CINAHL Complete, LILACS, SciELO, and Cochrane Library databases, using a search strategy developed with a librarian specializing in health sciences. The descriptors used were: *'nursing terminology' OR 'medical terminology' AND 'fundamental nursing' OR 'basic nursing' AND 'clinical assessment' OR 'physical examination' AND 'nursing education' OR 'nursing*

students', combined with specific Boolean operators for each database. For the Portuguese databases, the following descriptors were used: *'nursing terminology' OR 'medical terminology' AND 'fundamental nursing' AND 'physical examination' AND 'nursing education'.*

Articles published between 2018 and 2022, in Portuguese, English, and Spanish, addressing fundamental technical terminology in nursing, with a focus on semiology and semiotics, were included. The exclusion criteria were opinion articles, editorials, conference abstracts, and studies that did not present clear definitions of technical terms. The search resulted in 247 articles, of which 89 were selected after rigorous application of the inclusion and exclusion criteria by two independent reviewers, with 94% agreement (Kappa = 0.88).

Based on the thematic analysis of these studies, 120 technical terms most frequently used in fundamental nursing clinical practice were identified and conceptualized, organized into six thematic categories: Pulmonary/Respiratory, Abdominal/Genitourinary/Digestive, Neurological, Locomotor/Integumentary, Cardiac/Circulatory, and Head, according to the anatomical and functional classification established by the specialized literature. After all the terms were conceptualized, they were sent to specialists to validate their content and semantics.

The experts responsible for evaluating the internal content of the application were selected through intentional non-probabilistic sampling. The search for curricula was carried out on the Lattes platform of the National Council for Scientific and Technological Development (CNPq) and the terms used in the search were "semiology and semiotechnics", "physical examination" and "educational technologies in health". The inclusion criteria adopted were: being a graduate in nursing and achieving a score > 5 points in Fehring's criteria⁽¹⁷⁾. The points were distributed as follows: holding a master's degree (three points) and/or doctorate (two points), experience in educational technologies (three points) and clinical practice of at least one year (two points). The 5-point cutoff is considered a threshold that balances the need for expertise without excessively restricting the number of participants, allowing for diversity of experiences, but maintaining a minimum quality standard⁽¹⁸⁾.

After curriculum analysis, 399 specialist nurses were selected for the validation stage and invited to participate in the study. Of these, 56 accepted the invitation sent by email, exceeding the minimum number of 6 specialists recommended by Pasquali⁽¹⁹⁾ for validation. The instrument used for content and appearance validation was adapted from that used by Galdino⁽²⁰⁾, which includes specific criteria ranging from 1 to 3, as follows: Totally Adequate (TA); Adequate (A) and Partially Adequate (PA). Furthermore, it included a space where judges could say what they thought should be changed or adapted in the proposed technology before it was presented to the target audience.

Software programming and development

At this stage, the software was developed and programmed. The application was developed using the Flutter® language, maintained by Google®, allowing for cross-platform development, i.e. accessible via Android®, iOS®, Windows®, Mac®, Fuchsia®, and WEB devices without the need for adaptations or adjustments between platforms. This decision was made to include the largest possible number of students and specialists during the technology validation process.

Validation of usability by clinical experts

The inclusion criteria for clinical specialists were the same as those used for specialists in content and semantic validation. Clinical specialists received a link that allowed them to access a game interface, providing access to all functionalities. This same email contained a Google Forms® form with a characterization page followed by a System Usability Scale (SUS)⁽²¹⁾ in the Portuguese language version "*Escala de Usabilidade de Sistema*". The SUS is composed of ten questions, which assess whether people can actually complete their tasks and achieve their goals (effectiveness); the extent to which they expend resources to achieve their goals (efficiency) and the level of comfort they experience in achieving those goals (satisfaction). The users responded on a 1-5 point Likert-type scale, where each response is assigned a value for the calculation of the SUS score. A period of fifteen days was granted for the evaluation instruments to be returned.

Validating usability with students

In this phase, the inclusion criteria adopted were: being an undergraduate nursing student; having completed the course that addresses the content of the application, which is part of the fourth semester of the program; and attending the validation meeting. This group received an email with an invitation letter to participate in the study, containing the objective and a request for their interest in participating. Of the 39 students initially invited, six were excluded because they did not attend the meeting, resulting in a total of 33 participants.

The in-person meeting with the students was conducted in four phases: 1) presentation of the tool in slide format; 2) delivery and signing of the printed Informed Consent Form; 3) provision of the QR code to access the game; and 4) provision of the Microsoft Forms® link to answer the SUS scale. The students used the device for 30 minutes and then completed the validation form.

The data were processed using Software Package for the Social Sciences® (SPSS), version 20.0. To assess the level of agreement between items, the Content Validity Index (CVI) was calculated. This calculation was based on the sum of the ratings for each item, divided by the total number of judges or the target audience. The adequacy and relevance of each item were established with a minimum CVI of 0.70. Also, a Binomial test was performed for each item within the specified criteria (organization, clarity, comprehensiveness, and relevance), with a proportion of agreement set at 80% or more and statistical significance of $p > 0.05$.

To calculate the SUS scores, the following rule was used: for odd-numbered responses, 1 was subtracted from the user's score; for even-numbered responses, the participant's result was subtracted from the value 5. Finally, the scores of all 10 propositions from each judge were added together and multiplied by 2.5. The result, which ranged from 0 to 100, classified usability as: 20.5 (worst imaginable), 21 to 38.5 (poor), 39 to 52.5 (average), 53 to 73.5 (good), 74 to 85.5 (excellent), and 86 to 100 (best imaginable). A good score was considered to be a score greater than 68 points⁽²¹⁾.

The study was conducted according to national and international ethical guidelines, being approved

by the Research Ethics Committee of the Faculdade de Ceilândia of Universidade de Brasília (Protocol No. 3.693.438/2019, CAAE 21864619.0.0000.8093) and according to Resolution 466/2012 of the National Health Council. Informed consent was obtained from all individuals in writing and online. To guarantee anonymity, participants' names were replaced with codes in the database.

■ RESULTS

The validation process began with the evaluation of the application's internal content by 56 experts. The profile of these experts was predominantly female

(82.1%), mostly aged 40-45 years (33.9%) and a significant experience of 10 to 15 years (23.2%). 120 terms were evaluated, 20 from each thematic category. As shown in Table 1, the results demonstrated a high degree of agreement among the evaluators, with average CVI scores above 0.97 in all systems.

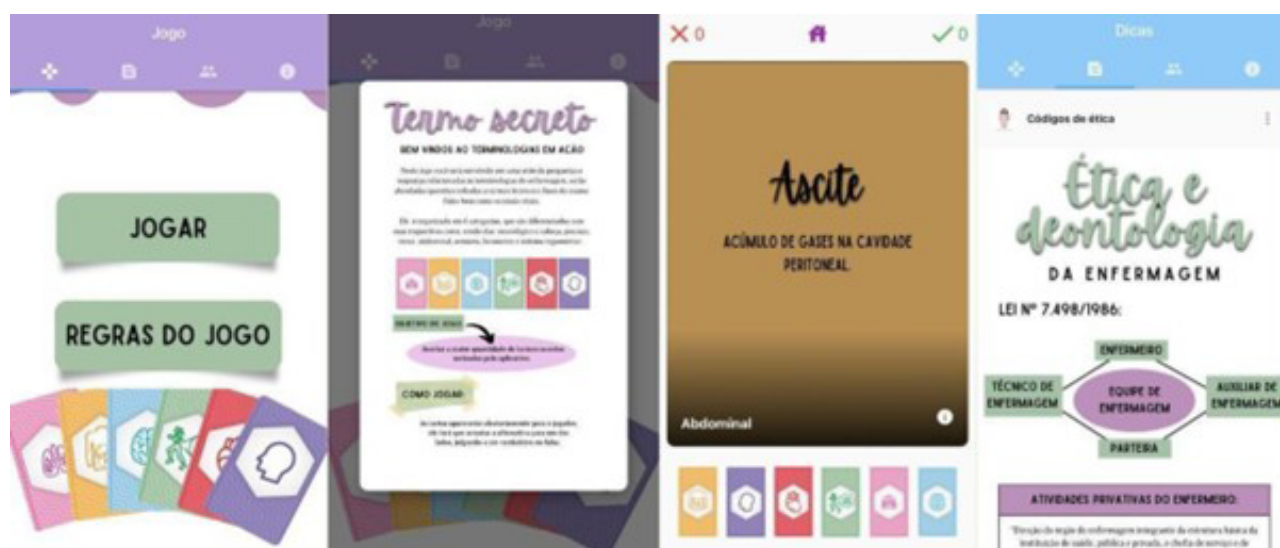
Subsequently, the technical development of the application proceeded. The tool has an initial interface for account creation and four main tabs: 1) the game, with rules and access to the match; 2) an online pocket guide with content on ethics, legislation, physical examination and technical terms, updated every two weeks; 3) a ranking of players; and 4) credits and information about authorship (Figure 1).

Table 1 - Mean and standard deviation of the evaluation regarding the content and semantics of the internal content. Brasília, Federal District, Brazil, 2024.

Thematic categories		Average	SD*
Neurological	Content	0.97	0.05
	Semantics	0.99	0.03
Pulmonary	Content	0.97	0.04
	Semantics	0.99	0.02
Head	Content	0.98	0.10
	Semantics	0.98	0.07
Abdominal	Content	0.99	0.03
	Semantics	1.00	0.01
Cardiac	Content	0.97	0.07
	Semantics	0.99	0.03
Locomotor	Content	1.00	0.01
	Semantics	1.00	0.01

Source: The authors, 2024.
Explanatory note: *SD, standard deviation.

Figure 1 – Game tab. Brasília, Federal District, Brazil, 2024.



Source: the authors (2024)

The game mechanics involve dragging cards to the right (correct) or the left (incorrect), with immediate visual feedback. The application can be accessed for free via the link <https://enfermagem-advinha.web.app/#/>.

The usability validation involved 11 clinical experts (faculty members) and 33 nursing students. The faculty members were mostly female, aged 40-50 years old, and with extensive clinical experience. The students were also predominantly female (over 90%), aged between 20 and 24 years old, and all reported believing that it is possible to learn through games.

The results from the SUS scale (Table 2) indicated high usability. Among the specialists, 91% considered the system to be not very complex and 100% felt comfortable using it. Among the students, 91% would like to use the application frequently, 100% did not consider it complex, and 94% reported that its functions were well integrated.

After usability validation (Figure 2), the overall values achieved on the SUS scale were 92.5 points for experts and 87.5 points for students, classifying the technology as “best imaginable” according to the study’s reference⁽²⁰⁾.

Table 2 - Percentage of agreement on usability, according to System Usability Scale. Brasília, Distrito Federal, Brazil, 2024.

	SUS	I completely disagree.		I disagree.		Undecided		I agree		I totally agree.	
		N	%	N	%	N	%	N	%	N	%
Clinical specialists	1	0	0.0	0	0.0	1	7.7	4	30.8	8	61.5
	2	9	69.2	1	7.7	2	15.4	0	0.0	1	7.7
	3	0	0.0	0	0.0	2	15.4	3	23.1	8	61.5
	4	9	69.2	2	15.4	1	7.7	1	7.7	0	0.0
	5	0	0.0	1	7.7	2	15.4	1	7.7	9	69.2

Table 2 – Cont.

	SUS		I completely disagree.	I disagree.		Undecided		I agree		I totally agree.	
Clinical specialists	6	7	53.8	3	23.1	2	15.4	1	7.7	0	0.0
	7	0	0.0	0	0.0	1	7.7	4	30.8	8	61.5
	8	9	69.2	3	23.1	1	7.7	0	0.0	0	0.0
	9	0	0.0	0	0.0	1	7.7	0	0.0	12	92.3
	10	7	53.8	1	7.7	2	15.4	3	23.1	0	0.0
Students	1	0	0.0	1	3.0	2	6.1	6	18.2	24	72.7
	2	31	93.9	2	6.1	0	0.0	0	0.0	0	0.0
	3	0	0.0	0	0.0	2	6.1	7	21.2	24	72.7
	4	27	81.8	4	12.1	0	0.0	2	6.1	0	0.0
	5	0	0.0	1	3.0	1	3.0	8	24.2	23	69.7
	6	24	72.7	7	21.2	2	6.1	0	0.0	0	0.0
	7	0	0.0	0	0.0	3	9.1	6	18.2	24	72.7
	8	26	78.8	3	9.1	1	3.0	3	9.1	0	0.0
	9	0	0.0	0	0.0	5	15.2	9	27.3	19	57.6
	10	21	63.6	7	21.2	2	6.1	3	9.1	0	0.0

Source: The authors (2024)

During the validation process, technical limitations were identified, such as incompatibility with older operating systems (prior to Android® 8.0 and iOS® 12.0) and the need for a stable internet connection. These limitations resulted in the need for technical support for 18% of the participants (n=8), but did not compromise the usability assessment, since all were able to complete the proposed tasks after receiving support.

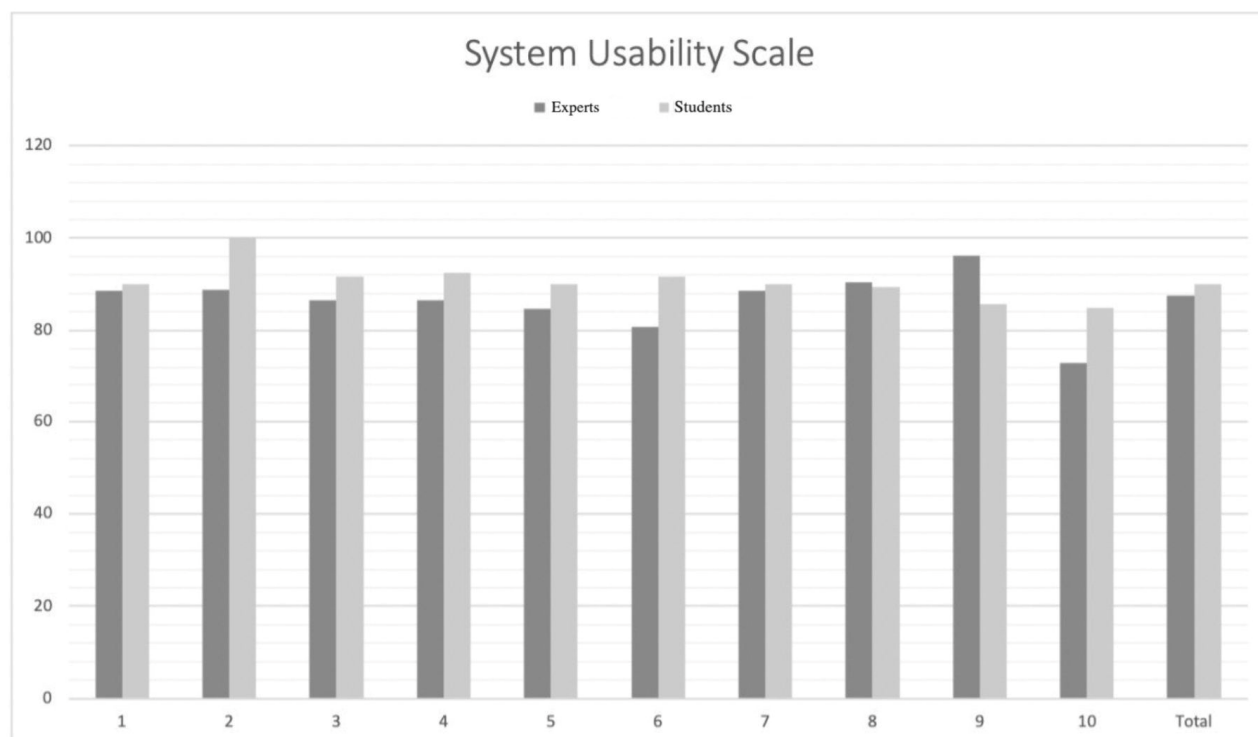
■ DISCUSSION

Based on the results presented, it can be inferred that the construction of mobile applications requires

validation with a coherent method, such as the SUS scale adopted in this study, which evaluates effectiveness, efficiency and satisfaction⁽²²⁾. Validation with experts and students was fundamental to correct flaws and ensure that the language and design were attractive to the target audience, contributing to the construction of educational strategies aligned with health education needs.

A recent study on the surgical patient safe care app⁽²³⁾ and another on the usability evaluation of the Quali + mobile app⁽²⁴⁾ demonstrate the relevance of methodological research for the creation and validation of digital tools.

Figure 2 – Final System Usability Score Scale between experts and students. Brasília, Federal District, Brazil, 2024.



Source: The authors (2024).

These studies emphasize the importance of a rigorous development process, which includes content validation by experts and usability evaluation with the target audience, ensuring the quality and applicability of technologies in clinical and educational practice.

The use of technology in teaching practices is expanding, with unlimited access to evidence-based information⁽²⁵⁾. Applications on mobile devices enhance the engagement of health students, who consult them more frequently than books and journals^(5,8,26). The SG presented in this study stands out for providing evidence-based information on Fundamental Nursing and for using gamification aspects such as competition and immediate feedback, making it attractive and engaging.

A systematic review study showed that the use of digital SG in nursing and medical education plays a significant role in improving academic training⁽²⁷⁾. Corroborating these findings, a meta-analysis highlighted that gamification enhances knowledge retention and the development of practical skills, especially when it incorporates elements of immediate

feedback and competition⁽⁵⁾, characteristics present in the TESE application developed in this study.

Technologies such as SG and M- learning are considered to facilitate the teaching-learning process, allowing for timeless teaching without geographical limits⁽²⁸⁾. Although the production of SG in nursing in Brazil is still scarce, it has been growing, for example focused on immunization⁽²⁶⁾. However, technology alone does not ensure an effective educational process; it must be a means used by educators to enhance learning⁽¹³⁾.

The adoption of standardized terminologies facilitates not only communication between professionals, but also the identification and approach to social determinants of health, expanding the scope and effectiveness of nursing care. In this context, the development of educational technologies that promote mastery of technical terminology from academic training, such as the SG presented in this study, is a promising strategy to improve professional practice and, consequently, the safety and quality of care⁽¹²⁾.

It is worth mentioning a recent study on educational technology for patient participation in the safe administration of antineoplastic chemotherapy⁽²⁹⁾, which illustrates how digital tools can empower patients and optimize the management of health conditions. This study highlighted the importance of developing technologies that meet the needs and preferences of users, promoting adherence and effectiveness of nursing interventions mediated by digital resources. The emphasis on usability and user experience is crucial for the success of these initiatives.

Furthermore, accurate recording of professional actions is essential for the quality and safety of care, as reinforced by COFEN Resolution No. 754/2024⁽³⁰⁾. The use of standardized languages, such as that promoted by the application, improves efficiency and communication among health professionals⁽¹⁾. SG go beyond entertainment, aiming at knowledge, training and decision-making^(5,7,9,10).

Technical limitations include the need to improve compatibility with older devices, implement robust offline functionalities, and enhance the interface for smaller screens. Regarding accessibility, the implementation of resources for visually impaired users (screen readers, high contrast) and support for Brazilian Sign Language (LIBRAS) is crucial for democratizing access to technology. However, it is recognized that such limitations may restrict the accessibility of the technology in contexts with limited technological resources or in regions with deficient internet infrastructure.

The present study meticulously describes the process of building and validating a technology in application format, designed for easy understanding and replication, thus providing a consolidated resource for the development and improvement of other technologies. By facilitating access to standardized information and promoting an interactive learning environment, the technology has the potential to enhance teaching and, consequently, serve as a support tool for improving clinical practice, the effectiveness of which should be confirmed in future studies.

■ CONCLUSION

The TESE application has demonstrated significant potential for improving clinical nursing practice, as evidenced by high user acceptance and positive usability results. The developed technology provides a solid foundation for enhancing interprofessional communication through standardized mastery of technical terminology.

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