

Research articles

Validation of interactive e-books as educational technology for a self-instructional online course on blood donation

Validação de e-books interativos como tecnologia educacional para curso online autoinstrucional sobre doação de sangue

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Abstract

Blood donation is essential for global health; however, the scarcity of blood components and derivatives represents a significant social challenge. In Brazil, recruiting blood donors requires strategies centered on education, sensitization, and raising awareness regarding social commitment. This study aimed to validate interactive e-books as educational technology for a self-instructional online course on blood donation. This is a methodological validation study involving eight hematology experts. Data collection utilized an instrument that assessed agreement regarding content, objectives, structure, presentation, and relevance. The results demonstrated a Content Validity Index (CVI) between 0.92 and 1.0. It is concluded that these interactive e-books constitute a valid educational technology for undergraduate health students enrolled in a self-instructional online course on blood donation.

Keywords: blood donation; educational technology; validation tests; nursing.

Resumo

A doação de sangue é essencial para a saúde global, e a escassez de hemocomponentes e hemoderivados configura-se como um relevante problema social. No Brasil, a captação de doadores de sangue exige estratégias de educação, sensibilização e conscientização quanto ao compromisso social. Este estudo teve como objetivo validar e-books interativos como tecnologia educacional para um curso on-line autoinstrucional sobre doação de sangue. Trata-se de um estudo metodológico de validação, com a participação de oito especialistas em hematologia. Para a coleta de dados, utilizou-se instrumento que avaliou a concordância quanto aos conteúdos, objetivos, estrutura, apresentação e relevância. Os resultados demonstraram índice de validade de conteúdo entre 0,92 e 1,0. Conclui-se que estes e-books interativos constituem uma tecnologia educacional válida para graduandos da área da saúde matriculados em um curso *online* autoinstrucional sobre doação de sangue.

Palavras-chave: doação de sangue; tecnologia educacional; testes de validação; enfermagem.

INTRODUCTION

Blood donation constitutes an essential component of global health, given that the unavailability of blood components and derivatives poses a grave social problem, considering that no artificial substitutes for human blood exist. To ensure universal access to safe blood and to strengthen the Unified Health System (SUS), it is imperative that countries maintain adequate stocks through voluntary, regular, and non-remunerated donors (Organização Pan-Americana de Saúde, 2022).

International studies have demonstrated that blood scarcity is a persistent challenge, especially in low- and middle-income countries, where communication and education interventions can positively influence the engagement of potential donors (Appiah et al., 2025; Sajwani; Gopakumar, 2024).

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However, in Brazil, a reduction of approximately 15% to 20% in the number of donations was observed compared to 2019. Such a decrease is a cause for concern, as it may compromise transfusion safety and the continuity of healthcare, particularly in contexts of emergency and high clinical demand (Organização Pan-Americana de Saúde, 2020, 2022). International literature also highlights that global events, such as the COVID-19 pandemic, significantly affected donor availability and blood supply, necessitating systemic responses to maintain stocks during crisis periods (Sajwani; Gopakumar, 2024).

Within the scope of public policy, the National Policy on Blood, Components, and Derivatives aims to guarantee Brazil's self-sufficiency in this sector and promote the coordination of government actions at all levels. This is operationalized through the National System of Blood, Components, and Derivatives (SINASAN), as provided for in Art. 8 of Law No. 10.205/2001. Nevertheless, despite this regulatory framework, donor recruitment remains a complex challenge that demands strategies capable of expanding the knowledge and understanding of the social, economic, cultural, and political aspects permeating voluntary blood donation.

In this context, the planning and development of didactic-pedagogical actions that favor critical reflection, the overcoming of fears and doubts, and the strengthening of conscious and responsible decision-making regarding blood donation are fundamental. The use of educational technologies stands out as a potentially emancipatory strategy by favoring the dissemination of knowledge, stimulating self-care, and qualifying the processes of communication, guidance, and health education among professionals, students, and the community (Jesus et al., 2020).

Digital educational technologies, such as interactive e-books, have significantly transformed teaching and learning processes. These tools enable greater dynamism, interactivity, and personalization of learning through the integration of multimedia resources, hyperlinks, and learning support instruments, thereby increasing user engagement and the effectiveness of educational actions (Reis et al., 2020). In the health field, such technologies prove particularly promising for the training and sensitization of health students, contributing to informed and socially committed practices.

Given the scenario above, the present study aims to validate interactive e-books as educational technology for a self-instructional online course on blood donation.

METHODS

This methodological study involved the validation of an educational technology, as proposed by Nietzsche, Salbego, and Lacerda (2021). It was conducted between February and July 2024 at a public state university located in the municipality of Petrolina, Pernambuco, Brazil. The study focused on content agreement validation regarding the objectives, structure and presentation, and relevance of interactive e-books, grounded in Pasquali's psychometric framework (2010). The validated educational technology consisted of interactive e-books developed for a self-instructional online course on blood donation entitled "Caring is in the blood: How to become a blood donor and encourage others to do so?" Chart 1 below presents the instructional design matrix of the course.

The course was designed and developed by members of the extension project Cuidar está no Sangue®, affiliated with the Study and Research Group on Theories and Practices of the Health and Nursing Care Process (GEPCuidar) at the University of Pernambuco, Petrolina Campus.

Theoretical-methodological framework for technology development

Contextualized Instructional Design (CID) was adopted as the theoretical-methodological framework for the development of the self-instructional online course and the interactive e-books, as it enables the systematic organization of the educational process, taking into account the context, target audience, and educational objectives. The course was designed to promote knowledge about the blood cycle, eligibility criteria for donation, and the social importance of voluntary blood donation, encouraging participants to become multipliers of this information through digital technologies, such as social media and other virtual environments.

Chart 1. Instructional design matrix of the self-instructional online course “Caring is in the blood: How to become a blood donor and encourage others to do so?” Petrolina, PE, Brazil, 2024.

Date / Version		07/27/2024 – Version 3				
Course Objective (expected learning outcomes at the end of the training process)		To understand the stages of the blood cycle, recognize the eligibility criteria for blood donation, and encourage others to donate blood.				
Roles / Activities		Content developers: responsible for the production/selection of content, monitoring course offerings, and conducting live sessions on social media platforms. Academic supervision: provides support to students regarding structural aspects of the course and the use of technological resources. Students: organize their study routine based on the guidelines and materials provided; interact with peers and content developers in pursuit of collaborative learning.				
Detailed description						
Course introduction		Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Title	Get to know our self-instructional continuing education course	Learn about the extension project “Caring is in the blood”	Understand the components of human blood and the blood network	Learn about the blood cycle: stages of blood donation	How to become a blood donor?	How to encourage others to become blood donors?
Content	Course objectives; Course structure; Course duration; Assessment and certification.	Teaching, research, and extension; University–community engagement through extension; The project “Caring Is in the blood”; Project activities for students and faculty.	Blood components and hematopoiesis; Blood components and blood derivatives; Blood network, blood centers, and transfusion agencies.	Recruitment and registration of candidates; Pre-screening; Clinical screening; Refreshment and hydration; Blood collection; Processing and fractionation; Laboratory testing; Storage and preservation; Distribution.	Donation eligibility criteria; Types of donation and donors; Myths and truths about blood donation.	Ethics, citizenship, and solidarity; Benefits of being a donor; Promotion of blood donation in communities and on social media.
Objectives	To present the self-instructional continuing education course “Caring is in the blood: How to become a blood donor and encourage others to do so?”	To present the extension project “Caring is in the blood.”	To identify blood components and understand hematopoiesis and hemotherapy.	To understand the stages of the blood cycle and describe recruitment, registration, screening, and blood collection procedures.	To understand donation criteria, distinguish myths from facts, and recognize different types of donation and donors.	To propose strategies to encourage blood donation and apply them within communities and social media contexts.
Duration	2 hours	10 hours	12 hours	12 hours	12 hours	12 hours
Instructional Resources (proposed media formats)	Introductory video lecture presenting the learning pathways; Introduction forum.	Interactive e-book; Video lecture.	Interactive e-book; Infographic; Video lecture.	Interactive e-book; Video lecture.	Interactive e-book; Video lecture.	Interactive e-book; Podcast; Instagram social media activities.
	Forum participation.	Access to recommended links and participation in Instagram polls.	Infographic-based quiz (Google Forms).	Quiz (Google Forms).	“Myths and Truths” game (interactive GSuite panel).	Development of an infographic for publication on social media platforms.
Assessment (how participants demonstrate learning)						
Source: Prepared by the authors.						

The course was structured into five units, each consisting of an interactive e-book and additional resources such as video lectures and infographics, aligned with the educational objectives of upholding ethical, legal, and humanistic principles; appropriately using digital technologies in nursing care; and planning health education and promotion actions tailored to the specificities of different social groups.

The e-books were developed according to the five phases of the CID Model: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (Filatro, 2010). In the analysis phase, a diagnostic assessment of the educational context was conducted to identify training needs related to knowledge about blood donation, considering the target audience, expected competencies, educational context, and available resources. During the design phase, alignment was established among educational and learning objectives, content, logical sequencing, and the didactic organization of materials. In the development phase, educational strategies, instructional resources, interactive and multimedia elements, and assessment instruments were created. The implementation phase involved making the course and e-books available in the virtual learning environment and verifying the functionality of technological resources. Finally, the evaluation phase comprised a systematic analysis of the educational technology, supporting the content validation process.

Content validation

Following the development of the e-books, content agreement regarding objectives, structure and presentation, and relevance was assessed using the Content Validity Index (CVI). Content validity is based on the systematic judgment of experts to verify the adequacy and representativeness of the material in relation to the construct of interest (Pasquali, 1997, 2010).

Participants (expert judges)

The panel of judges consisted of health professionals with expertise in hematology, including those with at least one year of professional experience in the field. Selection criteria included academic background, professional experience, scientific production or technical expertise, as well as interest and availability to participate in the study.

Experts were selected through an intentional and institutional process, beginning with an invitation to the coordinating blood center of the state of Pernambuco. To increase the number of participants, the Snowball Sampling technique was employed, whereby participants indicated other professionals with a compatible profile to join the study (Teixeira; Mota, 2020).

Data collection instrument

Data were collected using an instrument adapted from Teixeira and Mota (2020), structured into three domains: objectives; structure and presentation; and relevance. The instrument comprised 24 items assessed using a four-point Likert-type scale: (1) totally adequate, (2) adequate, (3) partially adequate, and (4) inadequate. Each item could receive a score from 1 to 4, resulting in a maximum total score of 96 points across all items.

The adaptation involved linguistic and contextual adjustments to ensure suitability for validating digital educational technologies in the format of interactive e-books on blood donation, while preserving the original structure and evaluation criteria. Prior to final administration, the instrument underwent critical review by the research team to ensure clarity, comprehensibility, and coherence of the items. No formal pretest with an external audience was conducted, as this study involved expert validation.

The instrument was applied individually to each of the five e-books: *Learn about the extension project "Caring is in the blood"; Understand the components of human blood and the blood network; Learn about the blood cycle: Stages of donation; How to become a blood donor?; and How to encourage others to become blood donors?*

Data collection and analysis procedures

The judges received, via email, an invitation letter, the Informed Consent Form, and links granting access to the e-books and the validation instrument, which was made available through the Google Forms® platform. Initially, participants completed a questionnaire to characterize their socioeconomic and professional profile.

Data analysis was conducted using a quantitative approach through the CVI, which ranges from 0 to 1. The CVI expresses the proportion of agreement among judges regarding the evaluated aspects of the instrument and was calculated as the ratio between the number of responses rated as “totally adequate” and “adequate” and the total number of responses, according to the following formula:

$$CVI = \frac{(\text{number of responses rated 1 and 2})}{(\text{total number of responses})} \quad (1)$$

A four-point Likert scale was used for evaluation: 1 – Totally adequate; 2 – Adequate; 3 – Partially adequate; and 4 – Inadequate. A CVI ≥ 0.70 (70%) was considered evidence of content validity, in accordance with methodological recommendations in the literature (Pasquali, 2010).

Additionally, suggestions and comments provided by the judges were subjected to qualitative analysis and incorporated into the instrument whenever deemed appropriate.

Ethical considerations

The study was approved on December 14, 2023, by the Research Ethics Committee of the Integrated University Health Center Amaury de Medeiros (CISAM/UPE), under approval number 6,581,324, CAAE 75387423.0.0000.5191. All ethical principles established by Resolution No. 466/2012 of the National Health Council were upheld, and all participants signed the Informed Consent Form.

RESULTS

A total of eight experts in hematology participated in the validation of the e-books. The panel consisted of five women and three men: two physicians, three nurses, one pharmacist, one biomedical scientist, and one nursing technician. The mean age ranged from 23 to 45 years ($\bar{x}=36.0$ years ± 7.23), with time since graduation ranging from 5 to 20 years ($\bar{x}=12.1$ years ± 5.62). Experience in the field of hematology varied from 1 year and 2 months to 20 years ($\bar{x}=7.5$ years ± 4.97).

Regarding the validation process of the e-books, the experts' opinions ($n = 8$) were analyzed quantitatively based on responses to an instrument covering three analytical domains: objectives, structure and presentation, and relevance for each unit's e-book. At the end of each section, the judges were provided the opportunity to offer qualitative comments and suggestions.

Table 1 presents the results for the Unit 1 e-book, titled “*Learn about the extension project Caring is in the blood*”, detailing the judges' responses and the CVI for each assessment domain. The objectives domain consisted of 5 items; structure and presentation comprised 12 items; and relevance included 4 items, totaling 24 items with a maximum cumulative score of 96. Based on the experts' evaluation of the domains and the e-book's purpose, all items achieved a CVI of 1.0 (100%), resulting in an overall mean CVI of 100% for the unit.

Table 2 presents the results related to the e-book of Unit 2, “*Understand the components of human blood and the blood network*”, structured according to the same domains and items as the previous unit. The CVI for the evaluated items ranged from 0.75 to 1.00. Despite this variation, the unit was considered consistent with its intended purpose, demonstrating a mean CVI of 92%. It is noteworthy that all suggestions and comments provided by the expert judges were carefully analyzed and incorporated into the material whenever deemed appropriate.

In Table 3, the expert judges highlighted the need for improvements in the structure and presentation of the Unit 3 e-book, “*Learn about the blood cycle*”. Although the objectives achieved satisfactory validation (87%), certain items related to structure—such as the logical sequence of the consistency and the clarity of the information—required adjustments, each obtaining a CVI of 0.87. The relevance of the topics was positively evaluated; however, scientific adequacy and writing style indicated the need for refinement. Despite the observed variation in the CVI values, the unit was considered consistent with its intended purpose, demonstrating a mean CVI of 94%.

Table 1. Responses of expert judges regarding the validation of Unit 1 – Learn about the extension project Caring is in the blood – according to objectives, structure and presentation, and relevance. Petrolina, PE, Brazil, 2024 (n = 8).

Items	TA*	A†	PA‡	I§	CVI¶
Block 1 – Objectives					
1.1 The information/content is consistent with the needs of the target audience	7	1	0	0	1.0
1.2 The information/content is important for convincing health students to become donors and/or advocates of this action	5	2	0	0	1.0
1.3 The information/content encourages and/or instigates changes in behavior and attitudes	7	1	0	0	1.0
1.4 The information/content can circulate within the scientific field of hematology	8	0	0	0	1.0
1.5 The information/content meets the objectives of Blood Centers	6	2	0	0	1.0
Subtotal	33 (82.5%)	6 (17.5%)	0	0	1.0
Block 2 – Structure and Presentation					
2.1 The e-book is appropriate for the target audience	8	0	0	0	1.0
2.2 The information is presented clearly and objectively	6	2	0	0	1.0
2.3 The information presented is scientifically accurate	7	1	0	0	1.0
2.4 The material is appropriate to the sociocultural level of the target audience	7	1	0	0	1.0
2.5 There is a logical sequence in the proposed content	6	2	0	0	1.0
2.6 The information is well structured in terms of grammar and spelling	6	2	0	0	1.0
2.7 The writing style corresponds to the knowledge level of the target audience	6	2	0	0	1.0
2.8 The cover, presentation, table of contents, and final remarks are coherent	8	0	0	0	1.0
2.9 The size of the title and headings is appropriate	7	1	0	0	1.0
2.10 The illustrations are expressive and sufficient	6	2	0	0	1.0
2.11 The page numbering is appropriate	7	1	0	0	1.0
2.12 The interactive buttons are appropriate	7	1	0	0	1.0
Subtotal	81 (84.3%)	15 (15.7%)	0	0	1.0
Block 3 – Relevance					
3.1 The topics addressed reflect key aspects that should be reinforced	6	2	0	0	1.0
3.2 The material allows transfer and generalization of learning to different contexts (academic and community)	6	2	0	0	1.0
3.3 The material promotes the construction of knowledge among university students	7	1	0	0	1.0
3.4 The material is suitable for use by any health professional	6	2	0	0	1.0
Subtotal	25 (78.1%)	7 (21.9%)	0	0	1.0
Overall Total	139 (83.2%)	28 (16.8%)	0	0	1.0

*TA – Totally Adequate; †A – Adequate; ‡PA – Partially Adequate; §I – Inadequate; ¶CVI – Content Validity Index;
Source: Prepared by the authors.

Table 2. Responses of expert judges regarding the validation of Unit 2 – Understand the components of human blood and the blood network – according to objectives, structure and presentation, and relevance. Petrolina, PE, Brazil, 2024 (n = 8).

Items	TA*	A†	PA‡	I§	CVI¶
Block 1 – Objectives					
1.1 The information/content is consistent with the needs of the target audience	6	2	0	0	1.00
1.2 The information/content is important for convincing health students to become donors and/or advocates of this action	5	2	1	0	0.87
1.3 The information/content encourages and/or instigates changes in behavior and attitudes	6	1	1	0	0.87
1.4 The information/content can circulate within the scientific field of hematology	6	1	1	0	0.87
1.5 The information/content meets the objectives of Blood Centers	4	3	1	0	0.87
Subtotal	27 (67.5%)	9 (22.5%)	4 (10.0%)	0	0.90
Block 2 – Structure and Presentation					
2.1 The e-book is appropriate for the target audience	4	4	0	0	1.00
2.2 The information is presented clearly and objectively	6	2	0	0	1.00
2.3 The information presented is scientifically accurate	5	1	2	0	0.75
2.4 The material is appropriate to the sociocultural level of the target audience	6	2	0	0	1.00
2.5 There is a logical sequence in the proposed content	8	0	0	0	1.00
2.6 The information is well structured in terms of grammar and spelling	5	1	2	0	0.75
2.7 The writing style corresponds to the knowledge level of the target audience	5	3	0	0	1.00
2.8 The cover, presentation, table of contents, and final remarks are coherent	8	0	0	0	1.00
2.9 The size of the title and headings is appropriate	7	1	0	0	1.00
2.10 The illustrations are expressive and sufficient	6	1	1	0	0.87
2.11 The page numbering is appropriate	6	2	0	0	1.00
2.12 The interactive buttons are appropriate	7	1	0	0	1.00
Subtotal	73 (76.0%)	18 (18.7%)	5 (5.2%)	0	0.94
Block 3 – Relevance					
3.1 The topics addressed reflect key aspects that should be reinforced	5	3	0	0	1.00
3.2 The material allows transfer and generalization of learning to different contexts (academic and community)	7	1	0	0	1.00
3.3 The material promotes the construction of knowledge among university students	7	1	0	0	1.00
3.4 The material is suitable for use by any health professional	5	1	2	0	0.75
Subtotal	24 (75.0%)	6 (18.7%)	2 (6.3%)	0	0.93
Overall Total	124 (74.0%)	33 (19.6%)	11 (6.5%)	0	0.92

*TA – Totally Adequate; †A – Adequate; ‡PA – Partially Adequate; §I – Inadequate; ¶CVI – Content Validity Index;

Source: Prepared by the authors.

Table 3. Responses of expert judges regarding the validation of Unit 3 – Learn about the blood cycle – according to objectives, structure and presentation, and relevance. Petrolina, PE, Brazil, 2024 (n = 8).

Items	TA*	A [†]	PA [‡]	I [§]	CVI [¶]
Block 1 – Objectives					
1.1 The information/content is consistent with the needs of the target audience	5	3	0	0	1.00
1.2 The information/content is important for convincing health students to become donors and/or advocates of this action	5	2	1	0	0.87
1.3 The information/content encourages and/or instigates changes in behavior and attitudes	5	2	1	0	0.87
1.4 The information/content can circulate within the scientific field of hematology	3	4	1	0	0.87
1.5 The information/content meets the objectives of Blood Centers	5	2	1	0	0.87
Subtotal	23 (57.5%)	13 (32.5%)	4 (10.0%)	0	0.90
Block 2 – Structure and Presentation					
2.1 The e-book is appropriate for the target audience	4	4	0	0	1.00
2.2 The information is presented clearly and objectively	4	3	1	0	0.87
2.3 The information presented is scientifically accurate	4	4	0	0	1.00
2.4 The material is appropriate to the sociocultural level of the target audience	6	2	0	0	1.00
2.5 There is a logical sequence in the proposed content	4	3	1	0	0.87
2.6 The information is well structured in terms of grammar and spelling	2	6	0	0	1.00
2.7 The writing style corresponds to the knowledge level of the target audience	6	2	0	0	1.00
2.8 The cover, presentation, table of contents, and final remarks are coherent	5	3	0	0	1.00
2.9 The size of the title and headings is appropriate	6	2	0	0	1.00
2.10 The illustrations are expressive and sufficient	4	2	1	0	0.75
2.11 The page numbering is appropriate	5	3	0	0	1.00
2.12 The interactive buttons are appropriate	6	2	0	0	1.00
Subtotal	56 (58.3%)	36 (37.5%)	3 (3.1%)	0	0.96
Block 3 – Relevance					
3.1 The topics addressed reflect key aspects that should be reinforced	4	4	0	0	1.00
3.2 The material allows transfer and generalization of learning to different contexts (academic and community)	4	4	0	0	1.00
3.3 The material promotes the construction of knowledge among university students	5	3	0	0	1.00
3.4 The material is suitable for use by any health professional	5	2	1	0	0.87
Subtotal	18 (56.2%)	13 (40.6%)	1 (3.1%)	0	0.96
Overall Total	97 (58.1%)	62 (37.1%)	8 (4.8%)	0	0.94

*TA – Totally Adequate; †A – Adequate; ‡PA – Partially Adequate; §I – Inadequate; ¶CVI – Content Validity Index;

Source: Prepared by the authors.

The results for the Unit 4 e-book, “How to become a blood donor?”, demonstrated strong overall validation, with all objective-related items receiving 100% agreement (CVI = 1.0). Regarding structure and presentation, clarity of information and appropriateness to the sociocultural level of the target audience were highly rated. The relevance of the topics—particularly the material’s capacity to instigate changes in behavior and attitudes—was also positively validated. The Global Content Validity Index (G-CVI) for this unit was 0.98 (98%), as shown in Table 4.

Table 4. Expert judges’ responses regarding the validation of Unit 4 – How to become a blood donor? – according to objectives, structure and presentation, and relevance. Petrolina, PE, Brazil, 2024 (n = 8).

Items	TA*	A [†]	PA [‡]	I [§]	CVI [•]
Block 1 – Objectives					
1.1 The information/content is consistent with the needs of the target audience	6	2	0	0	1.0
1.2 The information/content is important to persuade health students to become donors and/or encourage this action	7	1	0	0	1.0
1.3 The information/content invites and/or encourages changes in behavior and attitudes	5	3	0	0	1.0
1.4 The information/content may circulate within the scientific community in the field of hematology	4	4	0	0	1.0
1.5 The information/content meets the objectives of Blood Centers	5	3	0	0	1.0
Subtotal	27 (67.5%)	13 (32.5%)			1.0
Block 2 – Structure and Presentation					
2.1 The e-book is appropriate for the target audience	7	1	0	0	1.0
2.2 The information is presented clearly and objectively	5	2	1	0	0.87
2.3 The information presented is scientifically accurate	6	2	0	0	1.0
2.4 The material is appropriate to the sociocultural level of the target audience	6	2	0	0	1.0
2.5 There is a logical sequence in the proposed content	6	2	0	0	1.0
2.6 The information is well structured in terms of grammar and spelling	5	3	0	0	1.0
2.7 The writing style corresponds to the target audience’s level of knowledge	5	3	0	0	1.0
2.8 The cover, presentation, table of contents, and concluding remarks are coherent	6	2	0	0	1.0
2.9 The font size of titles and headings is appropriate	6	1	1	0	0.87
2.10 The illustrations are expressive and sufficient	5	3	0	0	1.0
2.11 The page numbering is appropriate	5	3	0	0	1.0
2.12 The interactive buttons are appropriate	6	2	0	0	1.0
Subtotal	68 (70.8%)	26 (27.1%)	2 (2.1%)		0.98
Block 3 – Relevance					
3.1 The themes addressed in the material reflect key aspects that should be reinforced	7	1	0	0	1.0
3.2 The material enables the transfer and generalization of learning to different contexts (academic and community)	5	2	1	0	0.87
3.3 The material promotes the construction of knowledge among university students	6	2	0	0	1.0
3.4 The material is suitable for use by any health professional	6	2	0	0	1.0
Subtotal	24 (75%)	7 (21.9%)	1 (3.1%)		0.97
Overall Total	119 (70.8%)	46 (27.4%)	3 (1.79%)		0.98

*TA – Totally Adequate; †A – Adequate; ‡PA – Partially Adequate; §I – Inadequate; •CVI – Content Validity Index;

Source: Prepared by the authors.

The validation of the Unit 5 e-book, “How to encourage others to become blood donors?”, yielded satisfactory results, with most items receiving high adequacy ratings, as shown in Table 5. The objectives, structure and presentation, and relevance were positively evaluated, indicating that the material is appropriate for its target audience. The CVI values ranged from 0.87 to 1.0, resulting in a Global Content Validity Index (G-CVI) of 0.99 (99%).

Table 5. Expert judges’ responses regarding the validation of Unit 5 – How to encourage others to become blood donors – according to objectives, structure and presentation, and relevance. Petrolina, PE, Brazil, 2024 (n = 8).

Items	TA*	A†	PA‡	I§	CVI¶
Block 1 – Objectives					
1.1 The information/content is consistent with the needs of the target audience	6	2	0	0	1.0
1.2 The information/content is important to persuade health students to become donors and/or promoters of this action	6	2	0	0	1.0
1.3 The information/content invites and/or encourages changes in behavior and attitudes	5	3	0	0	1.0
1.4 The information/content may circulate within the scientific community in the field of hematology	7	1	0	0	1.0
1.5 The information/content meets the objectives of Blood Centers	6	2	0	0	1.0
Subtotal	30 (75%)	10 (25%)			1.0
Block 2 – Structure and Presentation					
2.1 The e-book is appropriate for the target audience	6	2	0	0	1.0
2.2 The information is presented clearly and objectively	4	4	0	0	1.0
2.3 The information presented is scientifically accurate	7	1	0	0	1.0
2.4 The material is appropriate to the sociocultural level of the target audience	6	2	0	0	1.0
2.5 There is a logical sequence in the proposed content	5	3	0	0	1.0
2.6 The information is well structured in terms of grammar and spelling	5	3	0	0	1.0
2.7 The writing style corresponds to the target audience’s level of knowledge	4	4	0	0	1.0
2.8 The cover, presentation, table of contents, and concluding remarks are coherent	7	1	0	0	1.0
2.9 The font size of titles and headings is appropriate	6	1	1	0	0.87
2.10 The illustrations are expressive and sufficient	6	2	0	0	1.0
2.11 The page numbering is appropriate	6	2	0	0	1.0
2.12 The interactive buttons are appropriate	7	1	0	0	1.0
Subtotal	69 (71.9%)	26 (27.1%)	1 (1%)		0.99
Block 3 – Relevance					
3.1 The themes addressed in the material reflect key aspects that should be reinforced	6	2	0	0	1.0
3.2 The material enables the transfer and generalization of learning to different contexts (academic and community)	5	2	1	0	0.87
3.3 The material promotes the construction of knowledge among university students	7	1	0	0	1.0
3.4 The material is suitable for use by any health professional	6	2	0	0	1.0
Subtotal	24 (75%)	7 (21.9%)	1 (3.1%)		0.97
Overall Total	123 (73.2%)	43 (25.6%)	2 (1.2%)		0.99

*TA – Totally Adequate; †A – Adequate; ‡PA – Partially Adequate; §I – Inadequate; ¶CVI – Content Validity Index;

Source: Prepared by the authors.

The criterion for item acceptance regarding clarity and relevance was established as ≥ 0.70 for the CVI, specifically the Item-Level Content Validity Index (I-CVI). For the overall evaluation of the instrument, that is, the Global Content Validity Index (G-CVI), the calculation corresponds to the ratio between the sum of the I-CVI values and the total number of items in the instrument. I-CVI values < 0.70 determined the need for item revision or exclusion (Pasquali, 1997).

In addition to the quantitative assessments, the experts provided qualitative feedback throughout all units, which contributed to identifying specific areas for improvement.

DISCUSSION

The utilization of interactive e-books as Educational Technology (ET) for a self-instructional online course on blood donation represents a key advantage of distance learning. This format allows for temporal flexibility, enabling students to learn at their own pace and according to their individual demands, thereby fostering a more collaborative learning environment. Furthermore, it serves as a practical, rapid-access material equipped with digital resources that allow users to adjust font sizes, make annotations, highlight text, and access secondary sources with a single touch.

In the field of online education, and given the numerous advancements in digital technologies, the production of digital tools designed to encourage permanent education focused on social needs has become essential (Almeida et al., 2019). Consequently, the use of virtual environments for the development and implementation of educational technologies has become a common reality in the Brazilian context, as evidenced by a study conducted in Piauí, where an online course on gestational urinary incontinence was developed and validated (Tanaka et al., 2023).

Technologies provide support for the transmission of clinical evidence-based information. From this perspective, the development of health education materials benefit from an interdisciplinary approach where diverse knowledge bases complement one another, making the technology more engaging while remaining grounded in pedagogical pillars and scientific knowledge (Sousa et al., 2020). In this regard, according to Luna and Viana (2025), the primary educational technologies currently utilized include realistic simulations, gamification, digital tools, printed educational materials, and virtual learning environments. Thus, the present study aligns with the most widely used and contemporary technological repertoire in the healthcare landscape.

The results indicate that these e-books are a valid and effective tool for blood donation education, meeting the criteria of clarity, relevance, completeness, and utility. The high scores across all domains suggest that the material is appropriate for the target audience and can be utilized in both academic and community contexts. The suggestions provided by the experts will be incorporated to further refine the e-book content.

The adjustments made were primarily focused on: the revision of technical language, simplifying overly specialized terms and including conceptual definitions; the reorganization of the textual structure, prioritizing a sequential presentation of processes and segmenting content into topics and subtopics; the expansion of didactic resources, such as diagrams, flowcharts, and explanatory illustrations to facilitate process comprehension; and the inclusion of practical, contextualized examples related to the routine of hemotherapy services.

For instance, in the section regarding laboratory screening, explanatory boxes were added detailing the primary tests performed and their objectives; for blood fractionation, a flowchart was included detailing the stages of blood component separation; and in the topics on storage and dispensing, summary tables were incorporated covering conservation conditions, expiration dates, and release criteria for blood components. These adjustments enhanced the clarity and applicability potential of the e-book, reflecting positively on the adequacy of the evaluated items.

The discussion regarding the contributions of the expert judges was deepened, as their suggestions and comments played a fundamental role in complementing and qualifying the e-book content. The opportunity to propose changes based on scientific evidence allowed for the refinement of the terminology employed, ensuring greater conceptual precision and textual coherence, particularly in sections of higher technical complexity.

Furthermore, the experts' recommendations guided adjustments to visual resources, promoting better alignment between text and images, as well as the adaptation of diagrams, flowcharts, and illustrations to the stages of the described processes. These improvements favored expository clarity, the standardization of technical-scientific language, and content comprehension, contributing to the pedagogical effectiveness of the educational material.

Thus, the systematic incorporation of the judges' suggestions reinforced the methodological consistency and didactic quality of the developed e-books. From this perspective, the inclusion of hematology specialists in this process sought to provide a practical and meaningful material for the academic training of the target audience, given that specialist participation enhances the credibility and acceptance of educational technologies (Colares Bezerra et al., 2024).

CONCLUSION

It is concluded that the interactive e-books validated in this study constitute an appropriate and consistent educational technology for self-instructional online courses focused on blood donation. The results demonstrate that the materials possess content validity and pedagogical relevance, showing significant potential to support training processes and health education initiatives directed at the target audience.

The development and validation process of the e-books was grounded in scientific evidence and the meticulous judgment of subject-matter experts. This approach enabled the refinement of language, content organization, and the synergy between text and visual resources, thereby strengthening the didactic-pedagogical quality of the proposed educational technology.

Thus, this study contributes to the fields of health education and educational technologies by presenting a systematized methodological model for the construction and validation of interactive e-books, which is replicable across other themes and training contexts. Furthermore, it reinforces the potential of these technologies to enhance the academic training of health students and promote awareness of socially relevant topics such as blood donation.

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