Construction and validation of care-educational gerontechnologies: integrative review

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Abstract

Objective: identify in the literature how care-educational gerontechnologies have been constructed and validated and recommended propositions for their development. *Method:* integrative literature review carried out in the Web of Science, LILACS, CINAHL, BDENF, MEDLINE and SciELO databases following the recommendation of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). We selected studies that presented the construction and validation of gerontechnologies. For data extraction, we used an instrument adapted from the international RedENSO. We also classified the level of evidence of the studies according to Melnyk and Fineout-Overholt *Results:* We analyzed 17 studies. The year 2019 had the highest number of publications on the subject, with the majority coming from Brazil. The development of material gerontechnologies, as booklets, leaflets, manuals, games, software and multimedia materials, was more reported. Regarding the method of construction of gerontechnologies adopted in the studies, situational diagnosis through interviews, dialogues and scales, and literature reviews on the themes stood out. In most studies, validation was performed with the elderlies and, in some studies, validation was also performed with specialists. *Conclusion:* We found that the process of development of care-educational gerontechnologies is recent and requires improvement in the validation stage and not always performed by researchers. Regarding the recommendations for their development, we highlight the use of language accessible to older people and the association of theoretical and practical knowledge.

Keywords: Educational Technology. Elderly. Validation Study. Review. Evidence-Based Nursing.

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INTRODUCTION

Population aging is a global concern that involves issues about health, financial security and the distribution of families' financial resources to care for the older person. The Decade of Healthy Aging (2021-2030) was declared by the United Nations (UN) General Assembly in May 2020, with the aim of improving the lives of older people, their families and communities[1].

In Brazil, the strategic agenda of the Ministry of Health has among its objectives the guarantee of comprehensive health care for older people and those with chronic diseases at all levels of health care[2]. Meeting the demands caused by aging proves to be a challenge for the health system, since assisting this specific public requires a new form of health care and humanization of the care provided[3].

Comprehensive health care for the older person seeks to maintain functional capacity, promote autonomy and, consequently, quality of life. It is important to consider that aging does not mean being disabled. All assistance provided to older people must take into account their ability to judge and make decisions. It is important to encourage and ensure the exercise of autonomy in the older person's health care relationships[4].

In this sense, there are gerontechnologies, which seek to assist in the older person's daily activities[5]. It is an interdisciplinary field of study, as it involves technology, gerontology and aging, encompassing the development of techniques, products and services based on knowledge of the aging process[6].

Gerontechnologies have a vast field of action, including research, design and development of various technologies aimed at promoting the older person's quality of life. The possibility of action is wide, as in health, safety, assistance, communication and stimulation, for example[5].

Several types of gerontechnologies can be developed to expand the possibilities of health professionals in carrying out innovative and care-producing practices. Among them, care-educational gerontechnologies (CEGT) stand out, known as extremely important resources to complement health care and encourage patient participation, by encouraging self-care, and the family in the care process[7-9]. Some examples are: manuals, booklets, games, workshops, educational programs and software[10].

The CEGT enable the dissemination of knowledge, cause changes and influence the older person's health standard, in addition to increasing the possibilities of using new resources for care practices and health education[11]. From the shared construction of knowledge and the development of cognitive and affective skills, they encourage the patient to use their senses to think and relate these activities to their reality[7-9].

The development of these technologies in everyday practice should be encouraged, but they must be valid to prove their effectiveness before using them with the target audience[12]. Understanding how CEGTs are constructed and validated is useful for professionals who seek to develop them or who use them to support the care provided to the older person, using scientifically based materials with real results.

The present study aimed to identify in the literature how CEGTs have been constructed and validated and to propose recommendations for their development.

METHOD

This is an Integrative Review (IR), which plays a fundamental role in the development of Evidence-Based Practice (EBP)[13]. It was conducted in six steps: identification of the theme and selection of the research question; criteria for inclusion and exclusion of studies/literature search; categorization of studies; evaluation of included studies; evaluation of results and synthesis of knowledge. The period from study planning to completion was from June to October 2020[14,15].

The route taken to define the procedures for searching, selecting and analyzing articles followed the recommendations of the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) protocol[16].

The theme was the development and validation of gerontechnologies, aiming to answer the following guiding question: "What do methodological research articles reveal about the construction and validation of gerontechnologies?". For its elaboration, the PICo[17] strategy was used, acronym for population (older people), interest (methodological research articles on the construction and validation of care-educational gerontechnologies) and context (health care), adapted for use in non-clinical research.

Inclusion criteria were defined as being an original research article related to the construction and validation of care-educational gerontechnology, which was available in full online and free of charge, published in Portuguese, English and/or Spanish, with no time frame. Duplicate articles, other reviews and studies in which older people were not the target population were excluded.

The search for articles included in the review was carried out from secondary sources. Descriptors and Boolean terms were used in each database in a standardized way. To search for articles, the Web of Science, Latin American and Caribbean Literature on Health Sciences Information (LILACS), Database on Nursing (BDENF), Medical Literature Online (MEDLINE) and Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Scientific Electronic Library Online (SciELO) databases were selected.

The descriptors used for the search were consulted in the Descriptors in Health Sciences (DeCS) and their synonyms or equivalents in the English language in the Medical Subject Headings (MeSH) and CINAHL Titles. These were combined with the Boolean operators AND and OR, according to the systematic search strategy presented in Table 1.

Two reviewers independently gave their opinion on the inclusion of each study, and those that reached mutual agreement were selected, in order to avoid biased results. In this study, there was no need for a third reviewer to resolve conflicts. This step took place during the month of August 2020.

For data collection, an instrument composed of two sections was used, adapted from the form of the *Red de Enfermería em Salud Ocupacional* (RedENSO Internacional)[18], the first consisting of basic information about the publications, such as: title, name and training of the authors, year, country, database, language, journal, study type and level of evidence. The second part of the instrument contains questions related to the topic of interest, consisting of questions that addressed the name, type, classification, objective and content of the technology developed, essential characteristics for its development and validation and/or evaluation process.

The level of evidence (LE) was determined according to the classification by Melnyk and Fineout-Overholt[19] in: level I – systematic review or meta-analysis; level II – randomized controlled trial; level III – controlled study without randomization; level IV - case-control study or cohort study; level V – systematic review of qualitative or descriptive studies; level VI – qualitative or descriptive study; and level VII – opinion or consensus.

Table 1. Systematized search strategies. Picos, PI, Brazil, 2020.

Source	Strategy
MEDLINE	aged AND "educational technology"
WEB OF SCIENCE	aged AND ("educational technology" OR "health education") AND "validation studies")
CINAHL	aged AND "educational technology"
SciELO	aged AND (educational technology OR health technology)
BDENF	aged AND educational technology AND validation studies aged AND educational technology
LILACS	aged AND educational technology AND validation studies educational technology AND idoso.

Source: prepared by the authors.

The gerontechnologies found in the studies were determined according to the classification of educational health technologies by Teixeira[20,21] into material educational technologies – which are products, and intangible educational technologies – dynamic processes.

The selected studies were critically analyzed, and the extracted information was categorized according to the objects of interest and presented in tables containing the profile of the publications, the characterization of the gerontechnologies constructed, the methodological validation processes and the main recommendations for the development of gerontechnologies.

RESULTS

A total of 242 studies were retrieved, and 215 publications were excluded after reading the title and abstract because they did not answer the research question or because older people were not the target audience. Consequently, 27 publications were read in full, of which 10 articles were excluded, resulting in the composition of 17 primary studies for this integrative review, as detailed in Figure 1.

Among the studies analyzed, most did not exceed the limit of 10 years of publication, with 2019 being the year with the most publications. As for the place where the studies were carried out, Brazil was the outstanding country. The professionals who stood out in the construction of care-educational gerontechnologies were nurses, with a significant number of published studies.

Material gerontechnologies predominated, represented by booklets, leaflets, manuals, games, even software and multimedia materials. Immaterial gerontechnologies were also contemplated with the development of empowerment techniques and socio-educational groups. Table 2 was constructed by the authors to present the synthesis of data from each primary study included in the review.

As for the methodological characteristics for the construction and validation of the CEGT identified in the studies, they are presented in Table 3. Regarding the construction method, different processes performed by the authors were observed. Common points were found, such as the older people's situational diagnosis, reported by eleven studies, guided by the application of semi-structured interviews[24,25,27,30,35,36], dialogue[6,22,31] and scales[26,29,30], selected according to the purpose of each research. Six studies report carrying out a literature review on the topic to be addressed to support the subsequent elaboration of the technology content[21,24,25,31,34,36].

Regarding the validation process, six studies present gerontechnologies validated by specialists and older people[24,27,28,31,33,35], seven were validated only by older people[6,21,22,25,26,29,30], and four were not validated by the authors[23,32,34,36]. Regarding the methodological approach, qualitative studies stood out (n=15)[6,21-30,32,34,36], of which six were guided by the principles of Convergent Care Research[6,21,22,26,29,30], on the other hand, three studies had a quantitative approach, of the methodological research type[28,31,35], and two studies were quantitative-qualitative[28,34].

Considering the particularities of each study in the elaboration of gerontechnologies, respecting the peculiarities of the target audience, the recommendations considered essential for the construction process were summarized in Table 4, noting that they refer mainly to language, content and appearance. Level IV evidence was found on the construction and validation of gerontechnologies, being classified as such because they come from descriptive or qualitative studies.

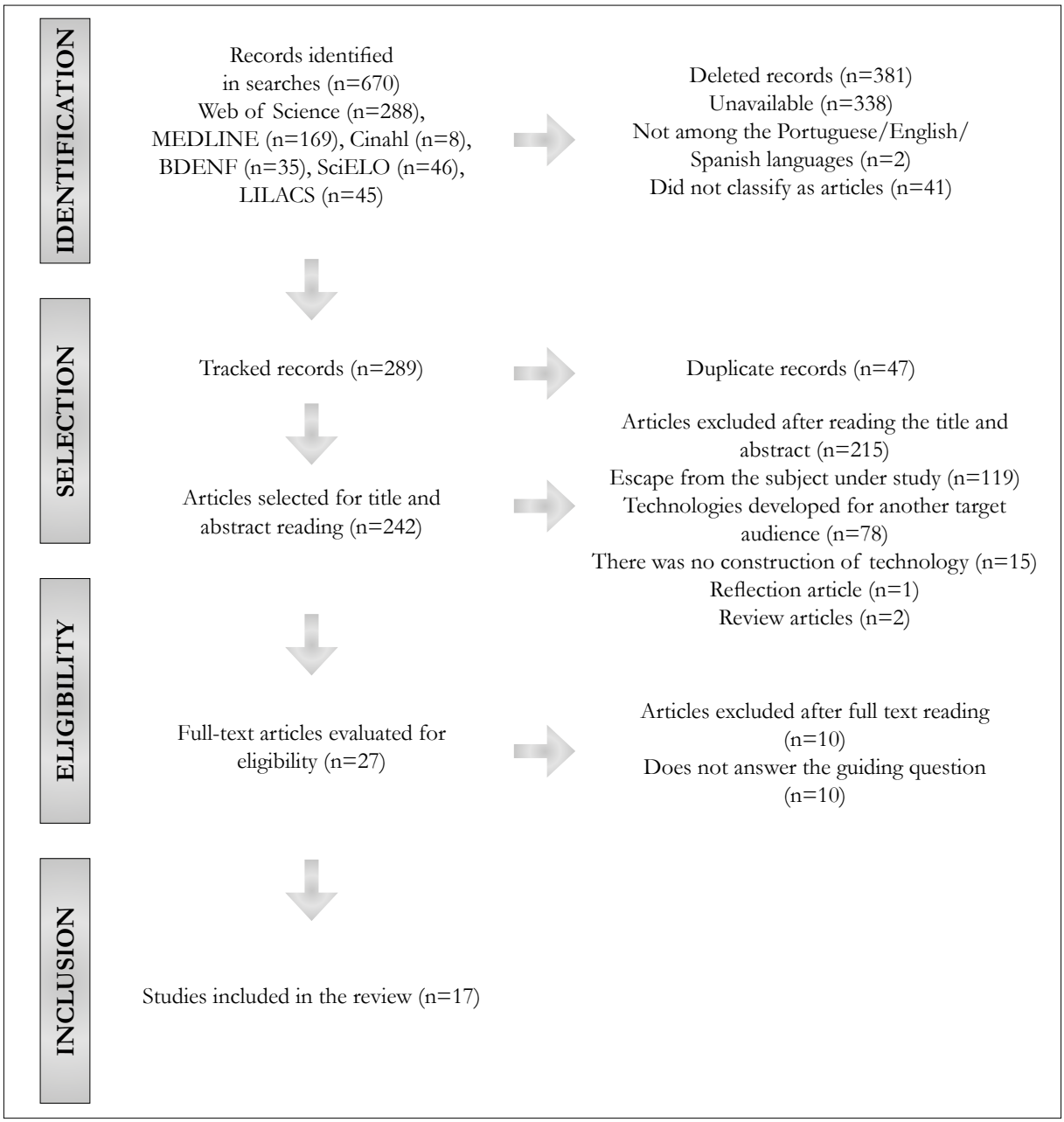

Figure 1. Flowchart for the selection of primary studies, adapted from the PRISMA recommendation. Picos - PI, Brazil, 2020.

Source: prepared by the authors.

Table 2. Characterization of the studies analyzed in the review. Picos - PI, Brazil, 2020.

Study coding	Authors/Training/ Year	Country	Type of Gerontechnology / Classification according to Teixeira[17]	Objectives
A1	Lucca et al.[21]/ Nurses/ 2020	Brazil	Cards game / Material	Promote the understanding of the older person undergoing hemodialysis treatment about the influence of their attitudes on their current health condition and quality of life.

to be continued

Continuation of Table 2

Study coding	Authors/Training/ Year	Country	Type of Gerontechnology / Classification according to Teixeira[17]	Objectives
A2	Gonçalves et al.[22] / Nurses / 2005	Brazil	Socio-educational Action Program / Immaterial	Favor self-care behaviors for the autonomy, independence and interdependence of hospitalized geriatric patients and their accompanying family members.
A3	Hammerschmidt et al.[23]/ Nurses / 2010	Brazil	Empowering Techniques / Immaterial	Develop the care process, encouraging the participation and active decision of older people with diabetes.
A4	Barros et al.[24]/ Nurses / 2012	Brazil	Educational booklet / Material	Educate caregivers and older people with a stoma about stoma care and prevention of complications.
A5	Pennafort et al.[25]/ Nurses / 2019	Brazil	Educational activity – banner and rag doll / Material	Guide older people with chronic kidney disease on hemodialysis about self-care in maintaining arteriovenous fistula, ensuring adequate access to effective dialysis therapy.
A6	Goes et al.[26]/ Nurses / 2016	Brazil	Convergence groups / Immaterial	Ensure the older person access to health services with transformative practices, providing well-being and quality of life in the family and community.
A7	Throfast et al.[27]/ Pharmacists / 2019	Sweden	*e-learning* modules / Material	Distribute information, through the internet, on the use of medicines.
A8	Rocha et al.[28]/ Nurses / 2019	Brazil	Guidance manual / Material	Mediate health education actions at the time of hospital discharge for family members and older people undergoing brain surgery.
A9	Costa et al.[29]/ Nurses / 2016	Brazil	Story telling / Immaterial	Stimulate older people's cognition and memory, social interaction and knowledge sharing.
A10	Ferreira et al.[30]/ Nurses / 2019	Brazil	Educational booklet, memory games / Material	Provide health promotion through the prevention of falls in older people with Parkinson's.
A11	Olympio et al.[6]/ Nurses / 2018	Brazil	Board game / Material	Promote active and healthy aging by maintaining functional capacity, cognitive stimulation, social interaction and obtaining knowledge about self-care.
A12	Carvalho et al.[31]/ Nurses / 2019	Brazil	Educational booklet / Material	Promote sleep hygiene in older people.
A13	Santos et al.[32]/ Physical therapists / 2018	Brazil	Software – Mobile Platform Application / Material	Stimulate older people's functional capacity to maintain functional independence.
A14	Macedo et al.[33]/ Speech therapists / 2020	Brazil	Educational guide / Material	Promote older people's vocal health through strategies, self-reflections and guidance on vocal self-care.
A15	Nakamura et al.[34]/ Speech therapists / 2018	Brazil	Multimedia material – interactive archive / Material	Guide and advise older people candidates for the use of hearing aids.
A16	Delatorre et al.[35]/ Nurses / 2013	Brazil	Educational guide / Material	Promote self-care of older people undergoing Percutaneous Transluminal Coronary Angioplasty (PTCA)
A17	Campos et al.[36]/ Speech therapists / 2010	Brazil	Multimedia material – didactic film / Material	Provide information for hearing-impaired seniors on the use and handling of the Personal Sound Amplification Device (PSAD)

Source: prepared by the authors.

Table 3. Methodological path for the construction and validation of care-educational gerontechnologies of the analyzed studies. Picos – PI, Brazil, 2020.

Coding / Study Type	Construction method	Validation by specialists	Validation by target audience	Validation method
A1/ Assistance Convergent Research	- Design (technical visits to the research site, problem definition and research objective, literature review for the synthesis of knowledge regarding the topic) - Instrumentation (delimitation/detailing of the physical space of the research, choice of participants and data collection instruments) - Scrutiny and analysis (researchers' entry into the reality of practice. Semi-structured interviews and conversation, unsystematic participant observation and analysis of medical records were used).	No	10 older people on hemodialysis.	Analysis: guided by apprehension, synthesis, theorization and transference. An evaluative instrument was used with the older people, with questions focused on the patients' feelings before and after the application of the game, for the recurrent learning and experience.
A2/ Assistance Convergent Research	Based on Orem's Self-Care Theory Built through dialogue with the subjects of care and self-care: the hospitalized older person, the accompanying family (future post-discharge caregiver) and the nurse, in an inpatient unit.	No	Does not specify number of participating older people	Assessment permeates the entire socio-educational action and takes place collectively in the group space. At the end of the meeting, the participants express themselves with their appreciations, suggestions and elaborations ("thinking") in the face of the group experience.
A3/ Experience report	Construction based on the professional routine of the authors themselves.	No	No	Not validated by the authors.
A4/ Qualitative	Semi-structured interviews with older people with stomas registered at the Stomatherapy Service (4 older people participated in this stage, chosen for being talkative, lucid and in good health). The data were organized by themes and scientific references were consulted to aid in the construction of the material.	1 nurse working for more than 16 years in the stomatherapy service	4 older people participating in the construction stage and 45 registered in the stomatherapy service	Problematized item by item with each participant and after fifteen days they were consulted about suggestions for changes in the text and images.

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Continuation of Table 3

Coding / Study Type	Construction method	Validation by specialists	Validation by target audience	Validation method
A5/ Action search	Established 04 phases: Situational diagnosis (semi-structured interview to identify the demand for information) Planning (development of educational technology guided by relevant literature) Action (carrying out the educational intervention with the application of the banner and rag doll built to guide fistula care) Assessment (performed after one month of the educational activity)	No	13 older people on hemodialysis.	Semi-structured interview about the knowledge learned by the older person with chronic kidney disease about the care provided by the researchers. Analysis by thematic category.
A6/ Assistance Convergent Research	Diagnostic assessment of living conditions and health of the older person (application of the Health Handbook of the Older Person and the Smilestein Family APGAR) with 30 participants. Strategic educational planning of the TCE, applied to older people selected by convenience, participants in the initial sample (Among the 30 in the initial sample, a group of 13 was formed that met the inclusion criterion of attending seven weekly meetings for two months).	No	13 older people	The assessment was based on the observation of empowerment for self-care, in signs emitted in the speeches: awareness of old age issues, changes in care practice related to coping with health complications in the course of aging.
A7/ Quanti-qualitative	Topics included in the modules were selected in collaboration with pharmacists through frequently asked questions asked by older patients on hospital wards or in pharmacies.	5 specialists (pharmacy, e-learning, web design, health informatics and medication informatics). Representatives of 2 pensioners associations	Initial assessment - 4 older people Final assessment - 16 older people	Initially, a prototype was developed, evaluated and validated by a small test group. The revised version of the prototype was then evaluated by a group of older people with a questionnaire about the content, layout and level of knowledge of the modules. A Likert-type rating scale was used. The results of the questionnaires were analyzed quantitatively using frequency analysis on an ordinal scale. Open questions were analyzed using qualitative content analysis.

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Continuation of Table 3

Coding / Study Type	Construction method	Validation by specialists	Validation by target audience	Validation method
A8/ Methodological research	The study deals only with the validation of gerontechnology.	11 specialists (5 nurses, 3 doctors, physiotherapist, pedagogue and graphic designer)	4 older people undergoing neurosurgery 4 family members	A Likert-type questionnaire was applied. Descriptive statistics were used to obtain the content validity index and semantic validity index.
A9/ Assistance Convergent Research	The research team performed immersion at the study site and experienced the context of the care and educational practice of the BHU among older people who circulated and participated in actions specific to the Senior Program. Technology planning: a diagnostic evaluation of the participating older people was carried out, applying the multidimensional instrument of active aging - AA and the WHOQOL–BREF quality of life assessment. The storytelling training plan for each older woman was drafted, in detail, when the stories to be told or retold were defined. The story was selected by the older woman herself, and there were weekly training sessions for three months, until the day of the presentations, which lasted about 3 hours.	No	8 older people	After the presentation of the stories, each of the older women storytellers made a subjective assessment of their own experience, guided by the question: "Tell me a little about your experience of having prepared and told a story". The WHOQOL – BREF was applied again in order to compare the quality of life results of the older women before and after the experience. The data obtained, of a subjective nature, were analyzed and interpreted from the process of storytelling appropriation.
A10/ Assistance Convergent Research	The study does not detail the construction of the gerontechnologies used, only that they were developed through clinical evaluation through scales, semi-structured interviews and applied in workshops, being later evaluated by the older people.	No	9 older people	Data from the workshops and interviews were transcribed in full and analyzed according to the thematic analysis, which consisted of three stages: pre-analysis, material research and treatment of results/inference/interpretation of the speeches exposed by the older people.

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Continuation of Table 3

Coding / Study Type	Construction method	Validation by specialists	Validation by target audience	Validation method
A11/ Assistance Convergent Research	Insertion of the researcher in the study setting Recruitment of participants through a lecture on the proposed topic. Individual interviews, creativity and sensitivity technique (CST) 'Almanaque', group discussion and participant observation were carried out.	No	31 older people	Research data were organized according to production techniques; The transcripts of the group discussions were recorded in audio, with electronic media, and the organization and digitization of the individual artistic productions. After the last group meeting, a conversation circle was held, with a script containing open questions that addressed the participation of each group member in the proposed educational strategy. After the floating reading of the corpus of the report of the data produced, the French discourse analysis was applied based on the triangulation of the data.
A12/ Methodological research	The content to compose the booklet was obtained through the guidelines of the Brazilian Sleep Association, the manual on the health of the older person and demands identified from a focus group with older people assisted at the study site. The content of the educational material was organized according to the theoretical framework of the health belief model.	22 specialists (nurses)	22 older people	For validation with the specialists, the Educational Content Validation Instrument (ECVI) was used, validated, For the target audience, an instrument adapted from the Suitability Assessment of Materials (SAM) was used, with 19 questions (regarding the understanding of the material) and with space for suggestions. Data analysis from the Content Validation Index and the binomial test.
A13/ Experience report	Construction based on the professional routine of the authors themselves.	No	No	Not validated by the authors.

to be continued

Continuation of Table 3

Coding / Study Type	Construction method	Validation by specialists	Validation by target audience	Validation method
A14/ Methodological research	The study only describes the items contained in the guide. It reveals that the design and layout work of the images was carried out by professionals in the specific area of communication and advertising.	13 specialists (speech therapists)	9 older people	For the evaluation of the specialists, an instrument developed by the authors was used on the content and appearance of the guide and it consists of the objective, structure, presentation and relevance of the product. The analysis consisted of matching the agreement and relevance of each item with a Likert-type scale. For statistical analysis, the Content Validity Index was used. For the target audience, initially, a Mini Mental exam was carried out. For evaluation, an instrument containing basic data was used to outline the profile, in addition to the response of its degree of agreement on the Likert scale, for the criteria of content, information, knowledge, illustrations, sensitivity and motivation, with an open question for possible comments. Statistical analysis was performed using the Content Validity Index and for the analysis of the open question, the Content Analysis Method proposed by Bardin was used.
A15/ Qualitative	A bibliographic study was carried out (survey of design factors to be incorporated in the elaboration of educational materials in the health area, and content of orientation and counseling to the older person candidate for hearing aids) Planning (defining and characterizing the target audience) Development of the multimedia material	No	No	Not validated by the authors.

to be continued

Continuation of Table 3

Coding / Study Type	Construction method	Validation by specialists	Validation by target audience	Validation method
A16/ Methodological research	Interviews (recorded) were carried out with 20 older people using a semi-structured questionnaire to identify the needs related to self-care when undergoing percutaneous transluminal coronary angioplasty to support the development of the technology. The interpretation, transcription of data and thematic content analysis were performed, from which the component categories of the educational manual emerged.	12 specialists (the study does not specify the professional category).	9 older people	For the specialists, a validation instrument was used on identification, instructions, objectives, structure and presentation, relevance of educational technology, using a Likert scale. For the target audience, the instrument evaluated instructions, objectives, organization, writing style, appearance and motivation, using a Likert scale. Statistical analysis was based on the simple frequency of the number of times the specialists and the older people chose the different assessments in each block of the instrument.
A17/ Qualitative	A multiple-choice questionnaire was applied, consisting of questions that addressed general aspects of the use and handling of the device and/or earmold, specific aspects of the difficulties presented and the user's opinion. A literature review was carried out on the subject for the construction of a script, used to guide the recording of the videos.	No	No	Not validated by the authors.

Source: prepared by the authors.

Table 4. Essential recommendations for the construction of a care-educational gerontechnology. Picos, PI, Brazil, 2020.

Study coding	Recommendations	Dimension	Evidence Level
A4, A7, A11, A12, A15	Association of theoretical and practical knowledge. Correct, reliable and current information. Included only necessary information. Relevance and level of content knowledge	Content	VI
A4, A8, A11, A12, A13, A14, A15	Easy-to-read content. Prioritization of basic information.		
A4, A8, A11, A12, A13, A14, A15	Simple, clear and understandable language and presentation, compatible with the older people's understanding. Avoid using jargon, technical or scientific terms, acronyms or abbreviations.		
A4, A8, A11, A14, A15	Alternate verbal and non-verbal communication. Incorporation of figures, diagrams or illustrations. Clear and understandable images. Use familiar images and symbols that appeal to the reader.	Language	
A4, A11, A15	Use of short phrases or key concepts.		
A4, A11, A14, A15	Consistency between text and image		
A13, A14	Adequate accessibility for older people. Accessibility intelligibility (content written in a simpler, easier to understand way).		
A15	Use familiar words, phrases and sentences. Repeat main words, phrases and ideas. Use active voice. Tell the reader what to do.		
A7, A8, A12, A13, A15	Proper layout. Participatory, simple and accessible design (text size, colors and audio clarity). Use of appropriate colors.	Appearance	
A1, A8, A12, A15	Adequate font size – 14, Times New Roman font, black color on white background and no gloss. Fonts for titles two points larger than those for the text. Appropriately sized material (neither short enough to compromise the quality of the information, nor long enough to be tiring) – 25 and 39 pages. Clear, understandable, enlightening and appropriately sized images.		
A1	Coating with Contact-type material – allowing asepsis before and after use.		
A1, A10	It should be playful, interactive and low production cost. Easily reproducible for independent use.		

Source: prepared by the authors

DISCUSSION

The findings of the study demonstrate that the scientific production on care-educational gerontechnologies is recent. Brazil was highlighted and the nurse was the professional with a significant number of publications. Studies with a qualitative approach and the construction of material technologies predominated. The technologies were built after carrying out a situational diagnosis and literature review, respecting important recommendations for the particularities of older people. Most studies carried out the validation process only with the target audience.

Brazil was the country where almost all the analyzed productions were carried out, which can be explained by the fact that the search was carried out mostly in electronic databases in Latin America and the Caribbean. Even so, this situation is connected with the care model adopted by the Unified Health System (SUS), which is based on the guidance of care practices and the search for a care model focused on health promotion and disease prevention[37].

The findings highlight the nurse as the professional with the greatest participation and contribution in the development of CEGT, which is related to the competences inherent to the profession, such as being responsible for guiding and educating, encouraging self-care. Nursing is usually surrounded by various educational practices, ranging from the communication and empowerment of older people to the development of software and educational materials[38].

The participation of nursing professionals in the development of CEGT corroborates the review study[39] in which Brazilian and nursing productions were highlighted. Another literature review[38] found advances in the development of technologies by these professionals in favor of care for older people, which leads us to perceive the insertion of this class both in the use and in the development of CEGT.

It is noticed that the field of study of care-educational gerontechnologies is in development when analyzing the timeline of the analyzed articles. This condition may be related to the decrease in reproductive rates and the decrease in the mortality of adults and older people, characterizing the population aging phenomenon. With the increase in life expectancy, chronic degenerative diseases are more frequent, which presses for new forms of care that preserve older people's autonomy and functionality[40].

It was possible to observe that for the construction of the CEGTs, a path formed by three stages was followed: situational diagnosis, literature review/planning and technology development. In the first stage, the researcher is inserted in the chosen place to seek information about the health situation of the population in question[41]. In the second stage, the search for scientific references that can support the writing of content and appropriate recommendations for the appearance of technologies aimed at older people is carried out[34]. After these two steps, the actual elaboration of the material takes place.

There are no specific methods, consolidated in the literature, for the construction of CEGT, however, based on what has been analyzed, the aforementioned steps are a path that can be followed by researchers, as some similarity in the conduct of the studies can be affirmed. They are important, because by following them, they allow the development of CEGT suited to the needs of the target audience, with language, content and appearance that allow older people to access true and current information and that are applicable during the care and self-care process[34, 41].

Regarding the characteristics of CEGT, there was a predominance of material gerontechnologies, among these, printed technologies were the most frequent, developed in six studies[24,28,30,31,33,35] and, although they bring different nomenclatures (manuals, guides, booklets), they are considered equivalent due to its printed form. In a review[42] carried out to identify educational technologies in health related to Cerebral Vascular Accident in the literature, there was also a higher frequency of use of printed materials.

Another review[38] points to the use of printed material as an effective technological tool by enabling the apprehension, exchange of knowledge and development of skills at home. A study[31] developed an educational booklet to mediate guidance on care for the peristomal skin of people with stomas, and they corroborate by highlighting that printed educational materials play an important role in health education, as they favor learning by having the possibility of being available to the patient and his family whenever doubts arise.

Two studies developed educational games, one with board[6] and the other with cards[21]. The use of the game as a gerotechnological product represents a break with the concept of educational activities based on the centrality of the disease, and emerges as a playful, natural and motivating strategy to promote self-determination, psychological, cognitive and social development, enhance self-esteem, exchanged experiences and shared learning among older people.

Still in relation to the material CEGT, it is possible to observe the production of digital educational technologies (DET), such as *e-learning* modules[27], multimedia materials (interactive archive and film)[34,36] and a software[32]. What these gerontechnologies have in common is that they need to be associated with Information and Communication Technologies (ICT), such as internet access and a smartphone, DVD or computer, to be used.

Therefore, the advantages of developing DET for older people involve visual, tactile and auditory stimuli that allow the use of several simultaneous and playful resources, instigating the construction of mental images, facilitating the memorization of information[43]. The studies that developed and used DET obtained satisfactory results in relation to the objective of the technology, in addition to the approval of its use by the target audience[27,32].

Regarding immaterial care-educational gerontechnologies, the development of educational actions was identified in four studies that carried out educational programs/group activities[22,26,29,44] and one study carried out individualized action, associated with the assistance provided[23]. Immaterial CEGTs work as instruments that favor autonomy and improve the living conditions of older people and contribute to the maintenance of biopsychosocial balance[45] through dialogic relationships between the educational and care process, which are essential to gerontechnology, humanizing relationships and promoting health care for the older person.

Regarding the development of care-educational gerontechnology, the validation process is essential, as it guarantees the quality and effectiveness of the product, which enhances health education carried out through technology. Validation is almost always done by specialists in the field to suit the material for the target audience. It can be carried out in line with the target audience or just with it depending on the type of technology and the researcher's objectives[20].

In this review, we observed a prioritization of validation with the target audience. The option of using an interview instead of a questionnaire for the validation of the CEGT by older people is very common and happens because it allows greater flexibility considering the specificities of this public. The interview is less tiring and when working with older people, the influence of limitations that may interfere with the success of data collection, such as decreased visual acuity and low level of education, must be mitigated, so that such factors do not mask the results of the technological intervention[46].

Regarding quantitative research for the creation and validation of CEGTs, it is considered that they have a more structured process that can be reproduced by researchers. This research method favors the availability of numerical measures that are more easily comparable to those of other validation studies. The three studies[28,31,33] that used it, validated gerontechnology both with specialists and the target audience, and used corresponding assessment instruments for each stage, such as the Educational Content Validation Instrument (ECVI) and the Suitability Assessment of Materials (SAM), very common in ET validation for other audiences.

It is necessary to draw the attention of researchers who develop gerontechnologies to the importance of validating these materials. Four studies[23,32,34,36] did not adopt any form of evaluation of the technology developed or applied, which becomes a risk, since in the case of older people, the adequacy of these materials must be even more careful and directed, taking into consideration the possible decay related to aging[34].

In view of the essential recommendations for the development of materials for older people, in terms of language and content, intelligibility and accessibility should be prioritized, with the content being written in a simple, easy to understand way. The suggestions are that the language used should be simple and clear, compatible with the older person's understanding. One should opt for short phrases or key concepts, avoid the use of jargon or technical terms, use verbal and non-verbal communication, and when using images and symbols, prioritize the most familiar ones, which are related to the older person's routine[6, 24,28,31-34].

If the purpose of creating an educational technology is to facilitate the apprehension of information, then readability and legibility must be taken into account in the construction process, as this will make it as easy as possible for readers to understand even when they have lower levels of literacy. It is reinforced that when it comes to materials aimed at older people, the possible sensory and cognitive decay of this audience must be considered[7].

One of the recommendations highlighted in this study refers to the alternation between verbal (written or spoken language) and non-verbal (illustrations) languages. A study[34] reinforces that the illustrations increase the attention and understanding of the

material, even by people with low levels of literacy. They also demonstrate that the recommendations regarding the design provide a greater understanding and help in the correct decision making. Thus, clear and understandable illustrations that are familiar to older people should be incorporated.

Abreu et al.[47] demonstrated that the structure and presentation of the technology is the most complex stage of the material because it involves aspects such as: layout, graphics, design and appropriate language for the target audience. The authors emphasize that the technology must present an adequate layout, appropriate colors and adequacy of scientific language to the language of the target audience, in addition to attractive and adequate illustrations so that the material is considered suitable for older people. As for immaterial technologies, they should stimulate social interaction and knowledge sharing and provide group coexistence[29].

Other recommendations found refer to playfulness and interactivity, factors that facilitate learning[48], and the type of material to be used for the preparation of care-educational gerontechnology, as it is recommended that the material allows asepsis before and after use, such as the Contact-type coating[21].

In the board game that was developed for older people[48], the researchers made it out of vinyl, with the application of Polyvinyl Chloride (PVC) and transparent lamination to protect the images. In addition, the game is stored inside a wooden box to ensure the durability of the material.

As for the level of evidence, the studies analyzed are categorized as descriptive or qualitative, being considered, by the tool used, as low level. However, this classification should not be associated with the poor quality of the method used, but with the nature of the construction and validation studies. It is essential that, for the development of CEGT, researchers take into account the level of evidence of the method used, developing research that can actually support the clinical practice of the health professional, considering the safety and ethics of the actions[49].

As limitations of the study, we point out the influence of the bases used, which are mostly from Latin America and the Caribbean, in relation to the scarcity of international studies on the subject; the low level of evidence by the classification of the evaluation tool used, since it only qualifies the methodological design used, but other points such as risk of bias and methodological quality were not evaluated in this review.

Even so, this research is relevant because it shows current knowledge about the construction and validation of CEGT, which will serve as a theoretical subsidy for nurses and other health professionals who seek to develop new instruments for the care of older people, associating scientific knowledge with dialogic educational care.

CONCLUSION

It was found that the process of developing care-educational gerontechnologies is recent and requires improvement in terms of the validation stage, which is not always performed by researchers.

As for the construction method, the common point was the realization of the older people's situational diagnosis, guided by the application of interview, dialogue and scales. The validation step, when carried out, was conducted most of the time with the target audience, and in some studies this process was also carried out with specialists.

The main gerontechnologies are of the material type, such as booklets, leaflets, manuals, games, software, multimedia materials. Still, immaterial technologies are present, such as empowerment techniques and socio-educational groups. Regarding recommendations for the development of gerontechnologies, aspects such as accessible language and the association of theoretical and practical knowledge stand out.

It is noteworthy, therefore, that this study presents a current synthesis on the subject, and shows the reader important information about the methodological path to be followed, contributing to the development of care-educational gerontechnologies that meet the specificities of the target audience and are validated by specialists and older people, with the aim of being accessible and reliable educational materials.

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