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REVIEW

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Educational technologies for children about parasitic diseases: an integrative review

Tecnologias educacionais para crianças sobre parasitoses: revisão integrativa

Tecnologías educativas para niños sobre parásitos: revisión integradora

Jaira dos Santos Silva[1], **Daniela Reis Joaquim de Freitas**[2]

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[1] Federal University of Piauí, Nursing Graduate Program – PPGENF/UFPI. Floriano, Piauí, Brazil.

[2] Federal University of Piauí, Nursing Graduate Program – PPGENF/UFPI. Teresina, Piauí, Brazil.

ABSTRACT

Introduction: Parasitic diseases have been causing serious public health problems around the world, especially in developing countries, with children being considered a more vulnerable group. **Aim:** To identify educational technologies developed for or aimed at children about parasitic diseases in the scientific literature. **Outlining:** This is an integrative review, carried out in the following databases: MEDLINE, via PubMed; Embase; Web of Science; SCOPUS (Elsevier); LILACS and CINAHL. The population, interest, context strategy was used, combined with controlled and uncontrolled descriptors and the Boolean operators AND and OR. The analysis of the studies occurred in a descriptive way. Two categories emerged: digital educational technologies developed for or aimed at children about parasitic diseases and non-digital educational technologies developed for or aimed at children about parasitic diseases. **Results:** Eleven studies were included. Digital technologies were identified, such as cartoons, videos, and PowerPoint presentations, as well as non-digital technologies, such as comic books, leaflets, board games and printed booklets. Educational technologies developed in school environments and/or in the community were found. The parasitic diseases covered were intestinal ones, the visceral leishmaniasis, malaria, Chagas disease, lymphatic filariasis and schistosomiasis mansoni. **Implications:** Digital and non-digital educational technologies have proven to be motivational, attractive, and complementary technological resources that contribute to children's active learning.

DESCRIPTORS

Educational Technology; Children; Parasites; Prevention of Diseases; Health Education; Nursing.

Corresponding Author:
Jaira dos Santos Silva
Address: BR 343, km 3,5 - Bairro Meladão.
Floriano, Piauí, Brazil.
ZIP Code:64800-000 – Floriano, PI, Brazil.
Phone: +55(89) 3522-2716
E-mail: jairasantos@ufpi.edu.br

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INTRODUCTION

The parasitic diseases are infections caused by classes of parasites such as the protozoa, the helminths, amongst others.[1] They are considered a severe worldwide socioeconomic problem, mainly in the least developed and developing regions. Some epidemiologically relevant parasitic diseases as a public health problem in the world are: ancylostomiasis, ascariasis, giardiasis, Chagas disease, lymphatic filariasis, schistosomiasis mansoni, cutaneous leishmaniasis, visceral leishmaniasis and malaria.[2]

In Brazil, despite the decline of morbidity and mortality since the 1960's, these diseases persist, in a scenario of epidemiologic and demographic transition marked by the concomitant predominance of communicable and chronic-degenerative diseases, by the resurgence of some diseases which already are in the process of control and elimination and by the contrast in the epidemiological picture between different regions of the country.[3]

Malaria is an important cause of morbidity and mortality in school-aged children. The tropical and subtropical areas of the planet are the most affected, with emphasis on Southeast Asia, the Amazon and Africa. The latter with 80% of all malaria cases and deaths in the world.[4]

Visceral leishmaniasis, also known as kala-azar, is fatal if left untreated. Most of the cases occur in Brazil, East Africa, and India. It remains one of the main parasitic diseases with potential for outbreak and mortality. In 2020, most of 90% of the new cases reported to World Health Organization (WHO) occurred in 10 countries: Brazil, China, Ethiopia, Eritrea, India, Kenya, Somalia, South Sudan, Sudan, and Yemen. Regarding cutaneous leishmaniasis, about 95% of cases occur in the Americas, the Mediterranean Basin, the Middle East, and Central Asia. In 2020, more than 85% of new cases occurred in 10 countries: Afghanistan, Algeria, Brazil, Colombia, Iraq, Libya, Pakistan, Peru, Syrian Arab Republic, and Tunisia.[5]

With regard to intestinal parasitic diseases, it is estimated that 200 million children worldwide are affected by intestinal parasites,[6] with Africa, Asia and Latin America being the places with the highest prevalence. Currently, in Latin America and the Caribbean, 59 million children live in areas at risk of infection or reinfection by soil-transmitted helminths (also known as geohelminths), or intestinal parasites. In Brazil, the North and Northeast regions point to a high number of cases of infected schoolchildren.[8]

In accordance with the Brazilian states, studies carried out in Argentina, Colombia, and Venezuela deal with the increase in cases of schoolchildren infected with intestinal parasites. They emphasize that tropical and subtropical regions are environments conducive to the spread of parasites, as well as extreme poverty, lack of basic sanitation, lack of access to comprehensive health care, low level of education of the guardians, and poor hygiene habits are described as major risk factors.[9-11]

These infections are part of the group of neglected tropical diseases, which justifies their persistence, mainly due to the scarcity or absence of public policies that guarantee the improvement of population's quality of life. They may present different morbidity and mortality events, such as diarrhea, malnutrition, intestinal bleeding, skin lesions, severe anemia or even death. These complications can compromise a child's physical and cognitive development, affect attention span and school performance, delay educational accomplishments, and impair economic development.[12]

However, the parasitic diseases are easy to treat and prevent, especially in Primary Health Care (PHC). This panorama highlights the relevance the theme imposes on the field of health and nursing. It is up to health professionals, especially nurses, to guide the child and their guardians for essential self-care practices in the community and in schools

through health promotion and disease prevention actions, together with Education professionals.[13]

To this end, educational technologies emerge as strategies that can be used by nursing in different care scenarios. To this end, educational technologies emerge as strategies that can be used by nursing in different care settings. For this, educational technology needs to be understood, so that it is incorporated into the care environment in line with the pedagogical approaches necessary for innovative teaching and the achievement of training skills that are intended within the scope of health education. In this way, health education actions supported by educational technologies enable human beings to experience the stages of their lives in a healthier way.[14-15] Given the above, in view of the lack of literature review on the subject, the magnitude and impact of parasitic diseases on children's health and the vulnerability of this public to such injuries, this study aimed to identify in the scientific literature the educational technologies developed or aimed at children about parasitic diseases.

METHOD

This is an integrative review carried out into sex steps: 1) elaboration of research question; 2) definition of the databases and criteria for inclusion and exclusion of studies; 3) definition of the information to be extracted from the selected studies; 4) evaluation of the studies included in the review; 5) interpretation of the results; 6) presentation of review/synthesis of the knowledge.[16]

The study was guided by a protocol developed by the researchers. The research question was prepared in accordance with the Population Interest Context (PICo)[17] strategy: (P) – children; (I) – educational technology; (Co) – parasitic diseases. That said, the following question was elaborated: what are the educational technologies developed or aimed at children about parasitic diseases available in the literature?

A search was carried out in the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE), accessed through the PubMed portal; Embase; Web of Science (WOS); SCOPUS (Elsevier); Latin American and Caribbean Literature in Health Sciences (LILACS), via the Virtual Health Library (BVS) and the Cumulative Index to Nursing and Allied Health Literature (CINAHL).

To conduct the searches, controlled and uncontrolled descriptors were used according to the requirement of each of the searched databases. In order to systematize the sample collection, the advanced search form was used, in order to respect the peculiarities and distinct characteristics of each database. The descriptors were combined with each other with the Boolean OR connector, within each set of PICo strategy terms, and then crossed with the Boolean AND connector (Chart 1).

Chart 1 - Databases, acronym, and search strategies. Teresina, PI, Brazil, 2022.

Database	Acronym	Search strategies
Medline (via Pubmed)	P	#1 "Child"[Mesh] OR (Children)
	I	#2 "Educational Technology"[Mesh] OR (Technology, Educational) OR (Educational Technologies) OR (Technologies, Educational) OR (Instructional Technology) OR (Technology, Instructional) OR (Instructional Technologies) OR (Technologies, Instructional)
	Co	#3 "Parasitic Diseases"[Mesh] OR (Disease, Parasitic) OR (Diseases, Parasitic) OR (Parasitic Disease) OR (Parasite Infections) OR (Infection, Parasite) OR (Infections, Parasite) OR (Parasite Infection) OR (Parasitic Infections) OR (Infection, Parasitic) OR (Infections, Parasitic) OR (Parasitic Infection)

	Combination	(("Child"[Mesh] OR (Children)) AND ("Educational Technology"[Mesh] OR (Technology, Educational) OR (Educational Technologies) OR (Technologies, Educational) OR (Instructional Technology) OR (Technology, Instructional) OR (Instructional Technologies) OR (Technologies, Instructional))) AND ("Parasitic Diseases"[Mesh] OR (Disease, Parasitic) OR (Diseases, Parasitic) OR (Parasitic Disease) OR (Parasite Infections) OR (Infection, Parasite) OR (Infections, Parasite) OR (Parasite Infection) OR (Parasitic Infections) OR (Infection, Parasitic) OR (Infections, Parasitic) OR (Parasitic Infection))
Scopus	P	#1 "Child"[Mesh] OR (Children)
	I	#2 "Educational Technology"[Mesh] OR ("Technology, Educational") OR ("Educational Technologies") OR ("Technologies, Educational") OR ("Instructional Technology") OR ("Technology, Instructional") OR ("Instructional Technologies") OR ("Technologies, Instructional")
	Co	#3 "Parasitic Diseases"[Mesh] OR ("Disease, Parasitic") OR ("Diseases, Parasitic") OR ("Parasitic Disease") OR ("Parasite Infections") OR ("Infection, Parasite") OR ("Infections, Parasite") OR ("Parasite Infection") OR ("Parasitic Infections") OR ("Infection, Parasitic") OR ("Infections, Parasitic") OR ("Parasitic Infection")
	Combination	"Child" [mesh] OR (children) AND "Educational Technology" [mesh] OR ("Technology, Educational") OR ("Educational Technologies") OR ("Technologies, Educational") OR ("Instructional Technology") OR ("Technology, Instructional") OR ("Instructional Technologies") OR ("Technologies, Instructional") AND "Parasitic Diseases" [mesh] OR ("Disease, Parasitic") OR ("Diseases, Parasitic") OR ("Parasitic Disease") OR ("Parasite Infections") OR ("Infection, Parasite") OR ("Infections, Parasite") OR ("Parasite Infection") OR ("Parasitic Infections") OR ("Infection, Parasitic") OR ("Infections, Parasitic") OR ("Parasitic Infection")
Web of Science	P	#1 ALL=("Child"[Mesh] OR (Children))
	I	#2 ALL=("Educational Technology"[Mesh] OR (Technology, Educational) OR (Educational Technologies) OR (Technologies, Educational) OR (Instructional Technology) OR (Technology, Instructional) OR (Instructional Technologies) OR (Technologies, Instructional))
	Co	#3 ALL=("Parasitic Diseases"[Mesh] OR (Disease, Parasitic) OR (Diseases, Parasitic) OR (Parasitic Disease) OR (Parasite Infections) OR (Infection, Parasite) OR (Infections, Parasite) OR (Parasite Infection) OR (Parasitic Infections) OR (Infection, Parasitic) OR (Infections, Parasitic) OR (Parasitic Infection))
	Combination	((ALL=("Child"[Mesh] OR (Children))) AND ALL=("Educational Technology"[Mesh] OR (Technology, Educational) OR (Educational Technologies) OR (Technologies, Educational) OR (Instructional Technology) OR (Technology, Instructional) OR (Instructional Technologies) OR (Technologies, Instructional))) AND ALL=("Parasitic Diseases"[Mesh] OR (Disease, Parasitic) OR (Diseases, Parasitic) OR (Parasitic Disease) OR (Parasite Infections) OR (Infection, Parasite) OR (Infections, Parasite) OR (Parasite Infection) OR (Parasitic Infections) OR (Infection, Parasitic) OR (Infections, Parasitic) OR (Parasitic Infection))
Embase (via Elsevier)	P	#1 'child'/exp OR 'child health'/exp OR (children) OR (health, child) OR (infant health)
	I	#2 'educational technology'/exp OR ('technology, educational')
	Co	#3 'parasitosis'/exp OR ('bone parasitic disease') OR ('parasite disease') OR ('parasite infection') OR ('parasite infestation') OR ('parasitic disease') OR ('parasitic diseases') OR ('parasitic infection') OR ('parasitic infestation')
	Combination	#1 AND #2 AND #3 = #4
LILACS (via BVS)	P	#1 Mh:Criança OR (Criança) OR (Child) OR (Niño) OR (Enfant) OR (Crianças) OR MH: M01.060.406$
	I	#2 Mh:"Tecnologia Educacional" OR (Tecnologia Educacional) OR (Educational Technology) OR (Tecnología Educacional) OR (Technologie de l'éducation) OR (Tecnologia Instrucional) OR MH: J01.897.280$
	Co	#3 Mh:"Doenças Parasitárias" OR (Doenças Parasitárias) OR (Parasitic Diseases) OR (Enfermedades Parasitarias) OR (Maladies parasitaires) OR (Infecções Parasitárias) OR (Infestações Parasitárias) OR (Parasitismo) OR (Parasitoses) OR MH:C01.610$

	Combination	(mh:criança OR (criança) OR (child) OR (niño) OR (enfant) OR (crianças) OR mh: m01.060.406*) AND (mh:"Tecnologia Educacional" OR (tecnologia educacional) OR (educational technology) OR (tecnología educacional) OR (technologie de l'éducation) OR (tecnologia instrucional) OR mh: j01.897.280*) AND (mh:"Doenças Parasitárias" OR (doenças parasitárias) OR (parasitic diseases) OR (enfermedades parasitarias) OR (maladies parasitaires) OR (infecções parasitárias) OR (infestações parasitárias) OR (parasitismo) OR (parasitoses) OR mh:c01.610*)
CINAHL	P	(MM "Child+") OR (MM "Child Health")
	I	(MM "Educational Technology") OR "nursing"
	Co	(MM "Parasitic Diseases+") OR "parasitosis"
	Combination	S1 AND S2 AND S3 = S4

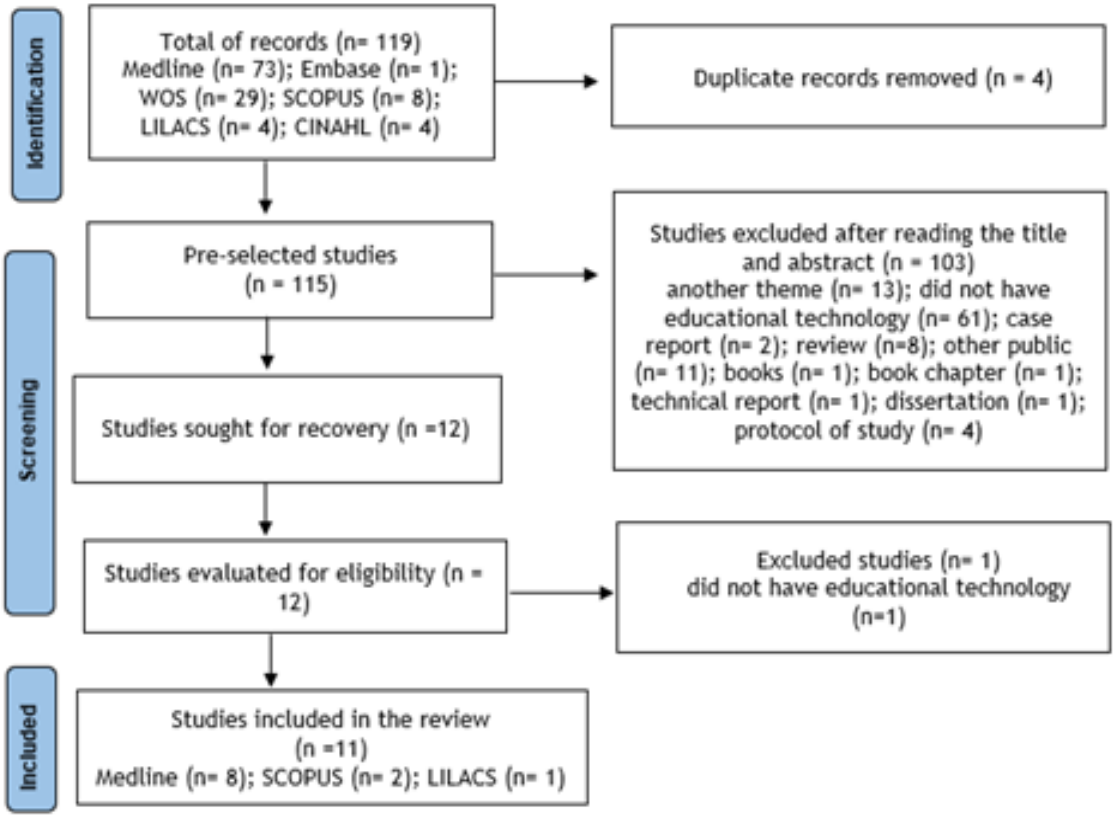
The search was carried out in October 2022, by two independent researchers, who standardized the sequence in which the descriptors were used and compared the results obtained. It should be added that, for validation purposes and greater consistency in the selection of publications, the results were compared, and disagreements were resolved by consensus between reviewers or with the inclusion, when necessary, of a third reviewer.

Primary studies that presented educational technology developed or aimed at children about parasites, in any language, were included. Documents in the form of dissertations, review papers, experience reports and those that did not respond to the research question were excluded. There was no temporal delimitation.

The studies found were input into Endnote Web software to exclude duplicates and then the Ryyan application, developed by Qatar Computing Research Institute (QCRI),[18] was used to assist the process of organization and selection of studies. For the extraction and synthesis of information from the selected studies, a form validated by the International Network of Nursing in Occupational Health (RedENSO) was used.[19] The following information was extracted: author(s), year of publication, country, journal, language, theoretical framework, objective, type of study, place where the study was developed, level of evidence, technology, technology classification and outcome.

The rank of the level of evidence was based on the assumptions of Melnyk and Fineout-Overholt.[20] The critical analysis, synthesis, and presentation of educational technologies were carried out in a descriptive way. 119 publications were identified (Figure 1).

Figure 2 - Selection of primary studies. Teresina, PI, Brazil, 2022.



Source: Adapted from Page.[21]

Four were excluded due to duplicity, resulting in 115 studies. After reading the titles and abstracts, 103 studies were excluded for not meeting the inclusion criteria, leaving 12 studies for full-text screening. After full reading of those, 1 study did not meet the eligibility criteria, leaving 11 studies for the final sample of this review. This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[21] recommendations.

Because it is an integrative review, this research was not submitted to the Research Ethics Committee, however the ethical and legal aspects of the authors of the publications used in the development of this study were maintained.

RESULTS

The evidence available on educational technologies developed or aimed at children about parasitic diseases emerged from the final sample of eleven studies,[22-32] presented according to authorship, year of publication, objective, and journal (Chart 2). Productions developed in Iran,[22] Argentina,[23] Thailand,[24] Morocco,[25] Nigeria,[26] Brazil,[27-28] Egypt,[29] Suriname,[30] Puerto Rico,[31] China were identified.[32] The studies were published between 1976 and 2021.

Chart 2 - Synthesis of the review papers, according to authorship, year of publication, aims and journal. Teresina, PI, Brazil, 2022.

Paper	Authors/year	Aim	Journal
A1[22]	Rezapour *et al.* 2021	To determine the effect of storytelling on preventing parasitic infection in elementary school students.	Iranian Journal of Health Education and Health Promotion
A2[23]	Rivero *et al.* 2017	To investigate children's knowledge and their perception about intestinal parasites and to evaluate the reconstruction of knowledge after specific training.	Zoonoses and Public Health

A3[24]	Nithikathkul *et al.* 2005	To reduce the rate of *Enterobius vermicularis* infections in children.	Journal of Helminthology
A4[25]	Ducrotoy *et al.* 2015	To explore the operationalization of an integrated system of messages on health.	Acta Tropica
A5[26]	Ajayi *et al.* 2009	To describe the development of a treatment guideline for malaria in children.	Patient Education and Counseling
A6[27]	Fernandes *et al.* 2021	To build and validate the content and appearance of a didactic game for teaching visceral leishmaniasis to elementary school students.	Semina: Biological and Health Sciences
A7[28]	Cunhaet *et al.* 2014	To evaluate the effectiveness of using a comic book as an instructional strategy for elementary school students.	Education in Biochemistry and Molecular Biology
A8[29]	El-Setouhy *et al.* 2003	Improving Egyptian schoolchildren's knowledge and attitudes about lymphatic filariasis.	Journal of the Egyptian Society of Parasitology
A9[30]	Locketz 1976	To evaluate the effectiveness of using video as an instructional strategy for elementary school teachers and students on *schistosomiasis mansoni*.	Pan American Journal of Public Health
A10[31]	Rigau-Pérez *et al.* 1996	To improve schoolchildren's knowledge about schistosomiasis mansoni.	Puerto Rico Health Sciences Journal
A11[32]	Yuan *et al.* 2000	To contribute to the development of material for children, with the production of a video and comics that could be used in schools in endemic areas for schistosomiasis.	Tropical Medicine & International Health

Regarding the databases, two (18.2%)[22-23] are in SCOPUS, eight (72.7%)[24-26,28-32] in MEDLINE via PubMed and one (9.1%)[27] in LILACS. The texts included were written in Persian (9.1%),[22] Portuguese (9.1%),[27] and English (81.8%).[23-26,28-32]

With regard to the research design, nine quasi-experimental studies were identified, of the before-and-after type (81.8%),[22-25,28-32] an intervention study (9.1%)[26] and a methodological study (9.1%). When evaluating the level of evidence, nine publications were ranked as level III (81.8%)[22-25,28-32] and two as level IV (18.2%).[26-27]

The journals addressed different areas such as health,[22-23,25-27,30-32] parasitology,[24,29] biochemistry and biological sciences.[28] Only one study based the construction/development of educational technology on a theoretical framework: Paulo Freire.[26] Regarding the educational technologies produced, soft-hard[22,24,27-30,32] and hard[23-26,30-32] technologies were identified. Figure 4 presents the synthesis of the review papers, according to educational technologies and main outcomes.

Chart 3 - Synthesis of the review papers, according to educational technologies and outcomes Teresina, PI, Brazil, 2022.

Paper	Educational Technologies	Outcome
A1[22]	Comic book	Significant reduction in reinfection with intestinal parasitic infections in the experimental group compared to the control group after an educational intervention.
A2[23]	Cartoon	After the ICTs, the children improved their knowledge. The approaches used were valuable tools to incorporate changes in misconceptions and ingrained habits that favor parasitic diseases.
A3[24]	Educational program (treatment and	Significant decrease in infections among children who received further education.

	preventive education), brochures and videos	
A4[25]	Integrated health messages, with PowerPoint presentation	Replacing words with local pictures and using "hands-on" activities improved receptivity; access and receptivity at schools was greater than at the community-level.
A5[26]	Cartoon	Technology has strengthened local capacity and increased acceptability and ownership of such materials.
A6[27]	Board game, booklet	The items were validated, which ensured the reliability of the instrument to be used by teachers to assess students' knowledge about visceral leishmaniasis.
A7[28]	Comic Book	The study illustrates an alternative to current strategies of teaching about the transmission of neglected diseases, it also promotes the diffusion of the scientific knowledge.
A8[29]	Comic Book	Knowledge about the ability to treat and prevent filariasis increased after reading the comic strip.
A9[30]	Video, brochures	It was found that the viewing by itself was not enough to ensure basic understanding of the schistosomiasis problem. Writing about the event reinforced the information conveyed and allowed children to relate the ideas presented to their own experiences.
A10[31]	Set of slides	The slides were used extensively in public schools and community lectures and served as evidence of educational programs to stimulate community development and health.
A11[32]	Video, Comic Books	A significant increase in knowledge about schistosomiasis in the intervention schools. This behavioral change suggests the value of short, targeted educational interventions to decrease risk of infection.

As for the place of development, educational technologies developed in the school environment[22-25,27-32] and in the community[25-26,31] were found. The parasitic diseases addressed by the educational technologies were intestinal parasitic diseases,[22-24] visceral leishmaniasis,[25,27] malaria,[26] Chagas disease,[28] lymphatic filariasis[29] and schistosomiasis mansoni.[30-32]

DISCUSSION

The papers were organized into two thematic categories for discussion: Digital educational technologies developed for or aimed at children about parasitic diseases and non-digital educational technologies developed for or aimed at children about parasitic diseases.

Digital educational technologies developed for or aimed at children about parasitic diseases

In this review, digital educational technologies developed or aimed at children on parasitic diseases in an international[23-26,30-32] context stood out, which confirms the relevance of the subject worldwide and highlights that national studies on the topic are still scarce. The digital educational technologies elucidated in the articles were: cartoons,[23,26] videos[24,30,32] and PowerPoint presentations.[25,31]

These results converge with studies on the production of educational technologies, which involve cartoons[33] and educational videos,[34-35] methods that were intended to generate empowerment in self-care, with the consequent construction of independence and autonomy of the subjects involved. Cartoons are innovative graphic animation resources that captivate children's attention and transform educational relationships through informative support, which uses sound, image, and interactive dialogue, in order to encourage collaboration in the teaching-learning process.[36]

Educational video was the most used digital technology in health education for children about parasitic diseases. The papers dealt with scientific investigations that were able to verify the effectiveness and feasibility of its use, as it provided the children who watched it with a virtual environment with multisensory experiences and easier and more effective learning.[24,30,32] In this

scenario, the use of images was essential to transform information into visual language, as a way of stimulating interest and facilitating children's understanding of the instructions that were given.

Given this, educational videos emerge as an important playful teaching-learning strategy, as they add visual and auditory resources to encourage the child to learn about and get involved with the topic covered, in a dynamic way. Therefore, to reach children, it is important that educational technologies are creative, interactive, easy to understand, in addition to having appropriate language for the audience in question.

Play has long been recognized as a way for children to deal with the challenges of illness and hospitalization. A study identified that in the last twenty years, playful interventions have been used in child health care, as: a form of preparation and support for procedures; non-pharmacological measure in pain management through distraction; educational support to enhance skills and attitudes about diseases, prevention, and treatment; way of promoting adaptation in different contexts, through recreation and activities aimed at coping with hospitalization by reducing anxiety.[37]

Thus, the approach of playful strategies in actions to promote children's health is important and necessary, since playful is conceived as recreation, play, having fun and that “playing” helps children to express their feelings and favors moments of reasoning and discovery. However, although this intervention represents a real possibility of comprehensive and humanized care for children, nurses still do not use it routinely in their practices.[38] That said, the use of playful strategies in nursing care practices becomes urgent.

Furthermore, the Covid-19 pandemic had a direct impact on children's educational practices, which migrated from their traditional form to remote teaching environments connected to the Internet. In this new global situation, teaching and learning activities were carried out through online platforms, virtual learning environments and educational technologies with the help of mobile devices and applications.[39] In this context, it is believed that the adoption of innovative strategies, which break with the traditional teaching model, add value to other opportunities to learn in a creative, dynamic and efficient way, allowing the subject to promote his own learning strategies and be protagonists in the construction of his knowledge.

A study found that among the resources that were cited by teachers as support for the teaching process, the triad formed by a computer, multimedia projector and slide editor (PowerPoint), together with the internet, was among the most mentioned items (46, 4%); in second place (30.9%), audiovisual resources (TV, speakers, CDs, DVDs, films, videos, video lessons, images, music). Database (magazines, institution information systems, social policy management systems, websites, search engines) corresponded to 12.4% of citations. Blogs, social networks, forums, WhatsApp, virtual communities, in turn, accounted for 10.3% of mentions.[40] Such findings show that digital technologies reconfigure the teaching scenario and serve as a resource for building knowledge beyond the classroom.

As for the take place environment, there was a relevant production of digital educational technologies developed at schools, with elementary school children. [23-25,30-32] In this context, the leading role in which the child is assumed, without equivocation and minority, as a subject of rights, who actively participates in research, reflects, and helps the researcher to (re)construct the framework of understanding of the phenomena that affect the child, bringing these subjects to the center of the health/diseases/care process.[41]

This evidence also reinforces the role of the school as a privileged *loci* for developing actions to promote and prevent risks and injuries. Partnerships in education and health projects in schools, as proposed by the School Health Program (PSE) and monitoring children in situations of greater

vulnerability are essential actions. To this end, the need to establish intersectoral and interdisciplinary intervention processes, organization of services and execution of nursing care is highlighted. The effectiveness of health education programs must consider the complementarity that exists between school health promotion and public policies defined for this purpose, in addition to considering the students' context and articulating different sectors.[42]

Some digital technologies were developed in the community.[25-26,31] Therefore, it is essential that educational actions focusing on the care of are developed individually and/or collectively, gradually, and continuously, strengthening families' care for their children at home, leading to increased confidence and parental autonomy, with a view to encouraging healthy practices, discouraging inappropriate conduct and contemplating actions to promote and prevent child health.[43]

When it comes to design of research, quasi-experimental studies stood out.[23-25,30-32] Such findings are pertinent as they instigate changes in the teaching-learning process, in order to contribute to the development of active and critical subjects, where subjects are evaluated before and after being subjected to an educational intervention/technology.[44]

The parasitic diseases addressed by the educative technologies were the instestinal[23,24] ones, visceral leishmaniasis,[25] malaria,[26] and schistosomiasis mansoni.[30-32] The neglect of these infections becomes evident, in studies, due to the lack of investment in public policies that guarantee an improvement in the quality of life for society, especially with regard to basic sanitation, making the population to be in contact with infectious agents. In this scenario, the role of nurses in health promotion is reinforced due to their task of coordinating the care plan and to the bond they establish with users, family members and caregivers through educational actions.[46]

The analysis of the primary studies included in this review showed weaknesses in the theoretical basis of research that developed and validated educational technologies for children, as only one study used theories to support this process.[26] Therefore, it is necessary for researchers to disclose and explain the theoretical foundations that supported the construction and/or application of the technology since the development of educational technologies, guided by theoretical references, enables the use of concepts and principles that enhance the reach of the expected educational objective. It also adds perspectives of contribution and appreciation to the science of nursing, through the recognition and application of its theories in the construction/validation of educational technologies for children.[47]

Regarding knowledge gaps, there was a lack of studies on digital educational technologies related to the topic carried out in Brazil and the absence of nurses in educational activities. Furthermore, the papers selected in this review presented a low level of evidence, which makes it difficult to establish cause and effect relationships between the educational technologies presented.

Non-digital educational technologies developed for or aimed at children about parasitic diseases

In this review, successful experiences were highlighted in studies that used non-digital educational technologies, such as: comic books,[22,28-29,32] educational leaflets,24,30 board games and printed educational booklets.[27] Among the features of these technological resources that most caught children's attention are: the images, the size, their structure, the dialogue between the characters and the onomatopoeia.

The productions revealed the predominance of comic books as a non-digital educational technology.[22,28-29,32] Regarding this panorama, it is known that comic books are inserted as a technological and didactic artifact that can contribute to students' learning, as they are easy to understand and stimulate a love of reading. That

said, the use of comic books as an educational technology can generate curiosity and interest in reading and encourage more active participation by children in the activities proposed in school spaces.[48-49]

Also, it was found that the use of games and printed educational booklets can be a useful and well-received tool by children to achieve information sharing.[27] These findings converge with other studies on the use of educational games,[50-51] which highlight that such educational resources can be considered as a two-way path in interaction with the child, through which the professional can communicate more effectively, with a understandable language, while at the same time providing a fun space for the child. In this way, the child directs his behavior through the meaning that the situation he experiences provides and engages in activities through which he can assume new identities, explore worlds, and learn through play.

When evaluating the outcomes of the studies,[22,24,27-30,32] it was observed that the children were protagonists of their own learning, reflected in their involvement and motivation. The active participation of school-age children and their knowledge were essential elements in health promotion and prevention actions. The use of non-digital educational technologies encouraged discussions, reflections, and the construction of collective knowledge.

In this context, non-digital educational technologies are relevant, as they have the potential to allow human beings to acquire knowledge of themselves and the context in which they are inserted, which makes them capable of understanding how their own actions influence their health standards and exert changes in this environment and in their own conduct.[52]

It was also found that some studies used both digital and non-digital technologies in their development.[24,30-32] The use of printed material, of the leaflet type,[24,30] (leaflets) guaranteed significant gains in knowledge for the participants of the studies. Thus, active methodologies must not be reduced to the use of technologies, mainly the digital ones. It is understood that non-digital and digital technologies are not exclusive, but complementary in the teaching-learning process. Each technology has its importance in the context of health education, and it is up to nurses and other professionals involved in the care process to choose those that best suit the reality of the study and the profile of the participants. It should also be noted that the use of technology should not reduce procedures to simple techniques, but strengthen relationships, facilitate dialogue, humanize care and health promotion.[53]

In this scenario, it is clear the importance of making this type of material available for use in health education activities developed by the nurse. However, it is emphasized the need to test the effect of the use of such materials by children in school environment and community, through randomized and controlled studies.

In this review, it was identified that the first technology developed for children was created in 1976, addressing schistosomiasis mansoni.[30] However, it was observed that in the 21st century, the production of such technologies gradually increased, especially in 2021, addressing intestinal parasitic diseases[22] and visceral leishmaniasis.[27] It is clear that the expansion of knowledge and the persistence of neglected diseases on a global scale have encouraged researchers to produce multiple technologies aimed at health education in the children's context.

However, more investments are still needed in the construction and validation of these materials, with a view to expanding the intervention possibilities for clinical practice.[54] Added to this is the need to comply with methodological rigor in the development of these educational technologies, since they impact decision-making in health and nursing and must go through a development process that guarantees their safety in terms of content, considering their inclusion in care processes. Thus, it

is imperative that the researchers to invest in the construction, validation, and evaluation of educational technologies aimed at children.

Regarding the professional category of the authors of the studies included in the review, the majority were developed by doctors, [22,24,28-30,32] only one study mentioned the participation of nurses.[27] Therefore, health professionals, especially nurses, must optimize strategies for health promotion, through educational actions, which enhance child's individual or collective participation and respect his autonomy.

Regarding knowledge gaps, there was a lack of recent studies related to the topic, as only two studies were published in the last five years, as well as little articulation by nurses in research scenarios.

CONCLUSION

Scientific evidence had showed that digital educational technologies, such as cartoons, videos, PowerPoint presentations, and non-digital educational technologies, such as comic books, educational leaflets, board games and printed educational booklets constitute motivational and, at times, complementary technological resources in the educational process of the children. Furthermore, they contribute to the development of the critical capacity of the child, which favors active learning and makes the child protagonist in the construction of their own knowledge.

In this review, the participation of nurses was scarce. However, it is known that their expertise in the care environment could contribute to the development of technologies that are more sensitive to children's needs. The geographic scope of studies in an international context is also highlighted, pointing out how fragile and incipient the production of technologies involving the subject has been in countries such as Brazil.

There was a predominance of quasi-experimental studies included in this review, however the effectiveness of technologies between intervention and outcome assessment was only tested in a few studies. In this manner, it is necessary to develop new studies with the application and measurement of the effects of using these technologies in different contexts.

RESUMO

Introdução: As parasitoses vêm ocasionando graves problemas de saúde pública no mundo, sobretudo em países em desenvolvimento, sendo as crianças consideradas um grupo de maior vulnerabilidade. **Objetivo:** Identificar na literatura científica as tecnologias educacionais desenvolvidas ou voltadas para crianças sobre parasitoses. **Delineamento:** Revisão integrativa, realizada nas bases de dados: MEDLINE, via PubMed; Embase; *Web of Science*; SCOPUS (Elsevier); LILACS e CINAHL. Utilizou-se a estratégia população, interesse, contexto, combinada com descritores controlados e não controlados e operadores booleanos OR e AND. A análise dos estudos ocorreu de forma descritiva. Emergiram-se duas categorias: tecnologias educacionais digitais desenvolvidas ou voltadas para crianças sobre parasitoses e tecnologias educacionais não digitais desenvolvidas ou voltadas para crianças sobre parasitoses. **Resultados:** Foram incluídos onze estudos. Identificaram-se tecnologias digitais, como desenhos animados, vídeos e apresentações em *powerpoint* e, tecnologias não digitais, como história em quadrinhos, folhetos, jogo de tabuleiro e cartilhas impressas. Encontrou-se tecnologias educacionais desenvolvidas em ambiente escolar e/ou na comunidade. As parasitoses abordadas foram parasitoses intestinais, leishmaniose visceral, malária, doença de Chagas, filariose linfática e esquistossomose mansônica. **Implicações:** As tecnologias educacionais digitais e não digitais revelaram-se recursos tecnológicos motivacionais, atrativos e complementares que contribuem para a aprendizagem ativa das crianças.

DESCRITORES

Tecnologia Educacional; Crianças; Parasitoses; Prevenção de Doenças; Educação em Saúde; Enfermagem.

RESUMEN

Introducción: Los parásitos vienen causando graves problemas de salud pública en todo el mundo, especialmente en los países en desarrollo, siendo los niños considerados un grupo más vulnerable. **Objetivo:** Identificar tecnologías educativas desarrolladas o dirigidas a niños sobre enfermedades parasitarias en la literatura científica. **Delineación:** Revisión integrativa, realizada en las siguientes bases de datos: MEDLINE, vía PubMed; Embase; Web de la Ciencia; SCOPUS (Elsevier); LILAS y CINAHL. Se utilizó la estrategia de población, interés y contexto, combinada con descriptores controlados y no controlados y operadores booleanos OR y AND. El análisis de los estudios se produjo de forma descriptiva. Surgieron dos categorías: tecnologías educativas digitales desarrolladas o dirigidas a niños sobre enfermedades parasitarias y tecnologías educativas no digitales desarrolladas o dirigidas a niños sobre enfermedades parasitarias. **Resultados:** Se incluyeron once estudios. Se identificaron tecnologías digitales, como dibujos animados, vídeos y presentaciones de PowerPoint, y tecnologías no digitales, como cómics, folletos, juegos de mesa y folletos impresos. Se encontraron tecnologías educativas desarrolladas en ambientes escolares y/o en la comunidad. Los

parásitos cubiertos fueron los parásitos intestinales, la leishmaniasis visceral, la malaria, la enfermedad de Chagas, la filariasis linfática y la esquistosomiasis mansoni. **Implicaciones:** Las tecnologías educativas digitales y no digitales han demostrado ser recursos tecnológicos motivadores, atractivos y complementarios que contribuyen al aprendizaje activo de los niños.

DESCRIPTORES
Tecnología Educativa; Niños; Parásitos; Prevención de Enfermedades; Educación para la Salud; Nursing.

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COLLABORATIONS

JSS and DRJF: substantial contributions to study's outlining, data collection and analysis, interpretation of results, writing and review of the manuscript, and final version to be published. **All authors agree and are responsible for the content of this version of the manuscript to be published.**

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AVAILABILITY OF DATA

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CONFLICTS OF INTEREST

There are no conflicts of interest to declare.