HOLOS
ISSN 1807 - 1600

DEVELOPMENT OF AN EDUCATIONAL TECHNOLOGY TO DETECT PHYSIOLOGICAL CHANGES IN CHILDHOOD AUTISM

L.B. FREITAS, J.F. LIMA JUNIOR, R.C.B. TEMOTEO, L.C. BENITEZ
Universidade Federal de Campina Grande
ORCID ID: https://orcid.org/0000-0002-6742-3505
larissabfreitas19@gmail.com

Submetido 12/08/2024 - Aceito 18/09/2024
DOI: 10.15628/holos.2024.16817

ABSTRACT

Autistic Disorder is a condition that causes impairments in language, behavior, and social interaction. This research is a methodological study that aimed to develop a Care-Educational Technology – CET (board game), directed to parents and/or caregivers, about the physiological changes present in childhood autism. The following stages were analyzed according to the objective of the game: (1) survey of the necessary content, through data collection; (2) selection of content and images; (3) definition of the design; (4) development of CET. As a result, there is an interactive game with 20 cards, 10 question cards and 10 answer cards; a board containing 30 squares; an instruction manual; a die and three pins used to advance during the game. It was concluded that the CET "Signaling Autism" is configured as a didactic tool, current and that it will be of paramount importance for the understanding of the symptoms of children with Autism Spectrum Disorder - ASD.

KEYWORDS: Health Communication, Educational Technology, Autistic Disorder.

DESENVOLVIMENTO DE UMA TECNOLOGIA EDUCACIONAL PARA DETECTAR ALTERAÇÕES FISIOLÓGICAS NO AUTISMO INFANTIL

RESUMO

O Transtorno Autístico é um distúrbio que causa prejuízos na linguagem, no comportamento e na interação social. Esta pesquisa trata-se de um estudo metodológico que objetivou o desenvolvimento de uma Tecnologia Cuidativo-Educacional – TCE (jogo de tabuleiro), direcionada para os pais e/ou cuidadores, acerca das alterações fisiológicas presentes no autismo infantil. Realizou-se as seguintes etapas analisadas de acordo com o objetivo do jogo: (1) levantamento do conteúdo necessário, através da coleta de dados; (2) seleção do conteúdo e das imagens; (3) definição do design; (4) desenvolvimento da TCE. Como resultado tem-se um jogo interativo com 20 cartas, sendo 10 cartas-pergunta e 10 cartas-respostas; um tabuleiro contendo 30 casas; um manual de instruções; um dado e três pinos usados para avançar durante a partida. Concluiu-se que a TCE “Sinalizando o Autismo” configura-se como uma ferramenta didática, atual e que será de suma importância para o entendimento das sintomatologias das crianças com Transtorno do Espectro Autista -TEA.

PALAVRAS-CHAVE: Comunicação em Saúde, Tecnologia educativa, Transtorno Autístico.

1 INTRODUCTION

Autism is classified in the Autism Spectrum Disorder (ASD) group and includes Asperger's Syndrome. The Statistical Diagnostic Manual of Mental Disorders declares autism as a neurodevelopmental disorder of neurobiological origin, which causes impairments in the interaction and social behavior of these individuals, as well as the presence of stereotyped, restricted and repetitive movements (American Psychiatric Association et al., 2014).

Regarding its diagnosis, it usually occurs in early childhood, around the first three years of age, this is because the child has a normal development until two years of age; only after this age will it be possible to identify some signs of regression in its development (Macedo et al., 2021). The specialists responsible for giving an accurate diagnosis are neurologists, psychiatrists or neuro-pediatricians, through a complete, detailed and individual clinical evaluation of each child, using information observed by parents and caregivers in the first years of life and through the application of specific instruments (Hofzmann, Perondi, Menegaz, Lopes & Borges, 2019).

The etiology of ASD is still unknown. On the other hand, due to the growing number of cases, science has started to study and understand more about this disorder to try to explain the increase in its prevalence in recent years (André, Montero, Félix & Medina, 2020). Regarding statistical data, the Center for Disease Control and Prevention of the United States Government reported that one out of every 54 children up to 8 years of age is autistic (CDC, 2020). Bringing this reality to Brazil, although the data are still uncertain, it is estimated that there are about 2 million autistic people, so 1% of the Brazilian population is within the spectrum (Freire & Nogueira, 2023).

Based on this logic, it is necessary to use different strategies, among which educational technologies that aim to detect the physiological changes of autistic children stand out, based on conceptions carried out by parents and caregivers, in order to raise awareness of the importance of understanding the behaviors of these individuals, promoting health education, improving the quality of life of family members and, consequently, of these children (Sousa, Rodrigues & Santos, 2022).

Added to this is the adaptation process of family members, which can be frightening and stressful at first, since the actions of an autistic child may be different from another who is not on the spectrum. Autistic individuals, in most cases, cannot have eye contact, take time to answer by name, have restricted interests and fascinations that can range from simple to genius things, are stuck in routines and change is something disturbing for them, have aversion to food textures or objects, have delays in verbal and non-verbal expressive language, are hypersensitive and have an imagination deficit (Orrú, 2020).

With regard to Health Care-Educational Technologies (CET's), they are considered efficient tools in the teaching and learning process and are directly related to the exercise of care and education, with the purpose of transmitting knowledge (Maciel et al., 2022). From this perspective, CET's can be of paramount importance for the awareness of the physiological changes present in these children, with the purpose that there is an understanding on the part of parents and caregivers of how to relate to their reactions, can lead to challenging situations inside and outside the family environment. In this sense, board games are configured as a didactic, efficient and cost-effective tool, because, through play,

the learning process becomes more fun, pleasurable and understandable (Zepponi, Braccialli & Pinheiro, 2021).

Given the above, this study aims to build a CET aimed at parents and/or caregivers about the main physiological changes of ASD. The current relevance of this theme in society stands out, given that studies are on the rise and the results of research collaborate to add more knowledge, produce improvements in family relationships within households, provide a better understanding of the neurophysiological changes of children with autism and add value to their quality of life.

2 METHODOLOGY

2.1 Type and location of study

This is a methodological research, of a descriptive nature, whose approach is the creation of a CET, the board game. The methodological study is outlined by the analysis, understanding and examination of the methods available for carrying out a scientific analysis. This type of investigation aims to provide more information, discuss and carry out a broad analysis of the verified observations, to produce qualitative answers in relation to the specific questions and, consequently, to promote more quality of life for the target audience (Prodanov & Freitas, 2013). To this end, a narrative review of the literature and the analysis of medical records of children with ASD treated at the Júlio Bandeira University Hospital (HUJB) were carried out.

The development of this CET was supported by the Laboratory of Health Information and Communication Technologies (LATICS), the Federal University of Campina Grande (UFCG), Cajazeiras-PB *campus* and HUJB.

2.2 Phases of the study

With regard to the study phases, the construction of the board game was divided into the following stages: (1) survey of the necessary content, through data collection; (2) selection of content and images; (3) definition of the design; (4) development of CET.

In stage (1), the analysis of 19 electronic medical records of children diagnosed with the autistic spectrum, made available by the Management Application for University Hospitals (MAHU) of HUJB, was used as a data collection instrument. Through the study of medical records, it was it is possible to detect the main physiological changes of the children who undergo the treatment, weekly, with the Occupational Therapist and the Speech therapist of the aforementioned health institution, which served as a theoretical basis for the information contained in the cards and in the board game manual.

In addition, to complement the theoretical content of the technology in question, a narrative review of the literature was carried out, using articles indexed in the databases of the Virtual Health Library -BVS, specifically, in the Latin American and Caribbean Literature in Health Sciences – LILACS and in the Medical Literature Analysis and Retrieval System Online - MEDLINE, the Scientific Electronic Library Online - SciELO and the Capes Journals. The selection criteria were given in the respective collections because they are bases with content involving health sciences and other specific and updated knowledge in the area of this study. The controlled health descriptors used in the search were: “Autism”, “Child autism”, “Autism Spectrum Disorder”, “Signs and symptoms” and the Boolean operator “AND”.

Inclusion criteria were articles published in the last five years (2018-2022), free of charge and with Portuguese and English as selected languages. Works in other languages, theses, dissertations or research that were outside the focus of the study and that did not fall within the aforementioned chronological interval were excluded from the research.

The initial selection in the VHL resulted in 380 articles, in SciELO only one (1) article was found and, finally, in the Capes Journals, seven (07) articles were located. After applying the inclusion and exclusion criteria, the final result consisted of nine (09) articles. To achieve the objective, a thorough reading of the research was carried out and the essential information was removed according to the theme, selecting the physiological changes that affected the neurodevelopment of autistic children.

Subsequently, in stage (2), the content and images were selected to compose the board game. After studying the physiological changes, the most relevant ones reported/observed by parents and/or guardians were selected, in addition to those found in the review to represent the cards of the game. In line with this, figures were captured in a bank of free images that related to the signs and symptoms of ASD.

In stage (3), there was a need to hire a designer to create the logo and select the color palette of the cards and the board. Thus, through meetings, the professional captured the fundamental ideas of the research and by sending some figures to serve as inspiration, which established a direct relationship with the theme, a symbol was created and the colors were defined to represent the entire prototype. Finally, the stage (4) consisted of the development of the game itself and the Canva Platform, which can be found at the following electronic address: https://www.canva.com/pt_br/, was used for the elaboration of the entire model.

2.3 Ethical and legal aspects

As this is a research involving human beings, it was submitted to and approved by the Research Ethics Committee of the Center for Teacher Education - CFP/UFCG, CEP opinion number 4.327.731. Also with respect to the rights of the research participants, all the norms determined in Resolution 466/12, of the National Health Council (NHC), of the Ministry of Health, which establishes the guidelines for research involving human beings, were followed, ensuring their anonymity.

Furthermore, there was full permission from HUJB to carry out the research, in which compliance with Brazilian Ethical Resolutions, in particular NHC Resolution 466/2012 and its supplements, was declared through a term of commitment.

3 RESULTS

3.1 Phase 1 – Content survey

After the release of access to the MAHU application, 19 medical records of autistic children monitored weekly by HUJB were made available by the Occupational Therapist for occupational therapies, consultations with the speech therapist and the neurologist. The age group ranged from 2 to 18 years and most were male, with sixteen (16) boys and only three (03) girls. The main physiological changes were synthesized in Table 1 below.

Table 1: Synthesis of the main physiological changes of autistic children attended by HUJB. Cajazeiras - PB/2022.

Child	Age	Sex	Main signs and symptoms
1	7 years	Male	Difficulty in speech, social interaction, stereotypes, auditory hypersensitivity.
2	7 years	Male	Language delay; stereotypes; difficulty socializing; auditory hypersensitivity.
3	3 years	Male	Food selectivity; little eye contact; sensory difficulty.
4	9 years	Male	Auditory hypersensitivity; irritability; difficulty interacting.
5	18 years	Female	Delay in motor and language acquisitions.

6	4 years	Female	Little eye contact; echolalia; stereotypes; stacks objects; verbal and non-verbal language failure, inflexible behavior; food selectivity.
7	5 years	Female	Delay in verbal language.
8	6 years	Male	Difficulty in fine motor coordination and social interaction.
9	3 years	Male	Absence of verbal language; irritability.
10	5 years	Male	Cognitive delay; auditory hypersensitivity; restricted and intense interests in letters, numbers and shapes; echolalia.
11	2 years	Male	Delay in speech and communication; little eye contact; hyperactive; food selectivity; auditory hypersensitivity; plays by rotating objects.
12	4 years	Male	Irritability; tiptoeing; food selectivity; failure in eye contact; hyperfocus on car brands; sensory, auditory and tactile alteration.
13	6 years	Male	Food selectivity; high skills: interest in English, Spanish, Russian. At the age of 2, she already spoke the names of colors, shapes, alphabets and fruits; stacks objects; auditory hypersensitivity.
14	2 years	Male	Tactile hypersensitivity; irritability; observant and non-exploring behavior; difficulty in speech.
15	9 years	Male	Interaction and social communication deficit; repetitive behaviors; episodes of psychomotor agitation.
16	3 years	Male	At 07 months he did not sit, did not look in the eye, did not interact, babbled little; echolalia; hypersensitivities; stereotypes.
17	3 years	Male	Irritability; food selectivity; little vocal/verbal repertoire in the first year of life.
18	18 years	Male	Impaired communication; delay in verbal language; difficulties in interpersonal relationships; social isolation.
19	9 years	Male	Problems of social interaction; echolalia; food selectivity; stereotypes; auditory hypersensitivity; difficulty in writing.

Subsequently, with the application of the inclusion and exclusion criteria, the articles were selected to complement the theoretical basis of CET. We opted for five articles in Portuguese and four in English, the studies reported the experiences and the main difficulties experienced by those responsible for dealing with ASD in daily life, before and after their finding. There were also approaches to diagnostic practices emphasizing the differences and similarities when comparing how the development of an autistic child and another child who is not on the spectrum occurs, in addition to explaining the behavior patterns and delays in the neurodevelopment process of these patients. The main results of the research were condensed in Table 2 below.

Table 2: Synthesis of scientific articles selected from the narrative review. Cajazeiras-PB/2022.

Title	Authors	Database	Year	Abstract
Child with autism spectrum disorder: care from a family perspective.	Lina D. Mapelli Mayara C. Barbieri; Gabriela V. D. Z. B. Castro; Maria A. Bonelli; Monika Wernet; Giselle Dupas.	LILACS	2018	It explains the experiences lived by families of autistic children after diagnosis. The most exposed difficulties ir the study refer to behaviors related to the lack of social interaction, discomfort with noisy environments and changing routines. In addition, there were reports about problems with feeding, in which most children presented food selectivity.
Maternal Observation: Early Signs of Maternal Autism Spectrum Disorder.	Bibiana M. Homercher; Laís S. Peres; Liziane F. dos S. Arruda; Luciane N. Smeha.	LILACS	2020	It reports the first signs of autism observed by mothers in the first months of childhood, before receiving the diagnosis of ASD. It was found that the most relevant signs were changes in language and behaviors, such as hyperactivity and repetitive movements, followed by social isolation, motor development disorders and hypersensitivities.
Childhood apraxia of speech evaluation in autism spectrum disorders: three clinical cases report.	Fernanda C. R. M. Martins; Fernanda P. Machado; Caroline S. R. da Silva; Ruth R. R. Palladino.	LILACS	2021	It addresses a case report after the application of an assessment to investigate apraxia of speech in three autistic children. The main results suggested that the research subjects presented moderate language delay with inconsistent speech, mainly in oral praxis tasks and oral motor skills.

Food and nutritional aspects of children and adolescents with autism spectrum disorder.	Tayná Magagnin; Marco A. da Silva; Rafael Z. de S. Nunes; Fabiane Ferraz; Jacks Soratto	LILACS	2021	It infers that children diagnosed with ASD have their own eating patterns, with restrictions and refusal of some foods, presenting food selectivity, in addition to compulsive behaviors in their daily consumption.
Aberrant Neural Activation Underlying Idiom Comprehension in Korean Children with High Functioning Autism Spectrum Disorder.	Namwook Kim; Uk-Su Choi; Sungji Ha; Seul Bee Lee; Seung Ha Song; Dong Ho Song; Keun-Ah Cheon.	MEDLINE	2018	It mentions a comparative study on behavioral and neural differences between children with and without ASD. Thus, neural differences were found between individuals, concluding that autistic children have a delay in understanding pragmatic language, with a unique neural pattern.
Social-communicative and attention problems in infancy and toddlerhood as precursors of preschool autistic traits	Esmé Moricke; Corina U. Greven; Janne C. Visser; Iris J. Oosterling; Jan K. Buitelaar; Nanda N. J. Rommelse.	MEDLINE	2019	It states that children with inconsistent behaviors accompanied by problems in interaction, communication, language, play and affection during the preschool phase are the main indicators and precursors of autistic traits.
Gastrointestinal Issues and Autism Spectrum Disorder	Moneek Madra; Roey Ringel; Kara G. Margolis.	MEDLINE	2020	It finds a direct link between gastrointestinal problems and ASD. Autistic children manifest bowel problems from early childhood and these are directly linked to other comorbidities, such as: sleep disorders, anxiety and hyperactivity. This leads to problems such as abdominal pain and constipation.
The profile of the child population with suspected diagnosis of autism spectrum disorder attended by a	Carla C. Rocha; Sara M. V. de Souza; André F. Costa; João Rodrigo M. Portes.	SciELO	2019	It clarifies the main signs and symptoms perceived by parents before receiving the autistic diagnosis. Among the main ones observed, there are deficits in language, externalizing and internalizing behaviors, cognitive deficit, and deficit in attention / concentration, stereotyped and restricted behaviors, hypersensitivity,

Specialized Rehabilitation Center in a city in southern Brazil. - Assessment of infant development in children with suspected autism spectrum disorder	Raquel Cymrot; Aline S. Bernardes; Luzia M. de Miranda.	Periódicos Capes	2021	sleep difficulties and sphincter control. It presents the analysis of the development of children with suspected ASD, using child development scales. After application, the authors found that there is impairment in five domains defined by them: cognition, communication (expressive and receptive), motor skills (fine and gross), adaptive behavior and socio-emotional.

3.2 Phase 2 – Content selection.

For the theoretical construction of the board game, the most pertinent signs and symptoms observed by parents and/or guardians were defined from the analysis of the medical records and, in line with this, those that most appeared in the research of the bibliographic review. From this perspective, the following physiological and behavioral changes of children with ASD were chosen: auditory hypersensitivity, language delay, food selectivity, difficulty in eye contact, socialization difficulties, stereotyped movements, and object stacking games, intolerance to change, echolalia and restricted interests. These signs and symptoms are present in the question cards and the answer cards. In addition to this information, the cards have figures taken from a bank of free images that exemplify each symptom.

3.3 Phase 3 – Designer definition

This phase occurred after all the content studied and developed for the creation of the CET. In this perspective, it was thought to hire a professional designer to develop a game that was aesthetically attractive to the target audience. Thus, through several meetings with the specialist, the colors that would represent the question cards, the answer cards, the board and the manual containing the rules of the game were defined. It should also be added that, because it is a playful technology aimed at the adult audience, she suggested using lighter, softer tones that had a direct relationship with the theme. Therefore, the CET palette involved green and blue colors, in light shades, as they are light, pleasant tones that are present in the main symbol of ASD: the ribbon represented by the infinity symbol. The models of the cards, the board and the manual are represented in Figure 1, Figure 2, Figure 3 and Figure 4.

HOLOS
ISSN 1807 - 1600

Figure 1: Example of question letters.

Figure 2: Example of response letters.

Figure 3: Board.

Figure 4: Manual containing the rules of the game.

3.4 Phase 4 – CET Prototype

The CET developed here has 20 cards, 10 question cards and 10 answer cards; a board containing 30 squares; a game instruction manual; one dice and three pins used to advance during the game.

The 10 question cards contain the following questions: 1 - Does your child bother with loud sounds? 2 - Does your child have language delay? 3 - Does your child show food selectivity? 4 - Does your child have difficulty in eye contact? 5 - Does your child have difficulties socializing with other children? 6 - Does your child exhibit repetitive movements frequently? 7 - Does your child usually play by stacking objects in a well-organized way? 8 - Is your child often very attached to routines and resistant to change? 9 - Does your child seem to enjoy repeating words and sounds he has heard on TV or from other sources? 10 - Does your child have restricted and intense interests in a specific topic?

The 10 answer cards have the following explanations: 1 - Auditory hypersensitivity causes affliction in autistic people, who are more sensitive to sounds and noises. 2 - Autism is characterized by difficulties in communication and delayed speech. 3 - Children with ASD have restricted and selective behaviors that affect their eating habits. 4 - Eye contact is uncomfortable for autistic people, so they do not express themselves by looking. 5 - Some autistic children may have limitations in social interaction with other children. 6 - Repetitive movements are stereotypes performed in situations of stress and anxiety. 7 - Autistic people usually play with objects rigidly and spend hours performing this same activity. 8 - One of the characteristics of autism is rigidity in thinking, they are stuck in routines and exhibit inflexible behaviors. 9 - Autistic people repeat words in the same intonation and order they heard somewhere, the so-called echolalia. 10 - From an early age, children with ASD have what we call hyperfocus on some topic that they have an affinity for.

In relation to the board, it consists of 30 squares, with the squares numbered 1 to 10 corresponding to the question square, the empty squares corresponding to the "pass by" and, finally, we

have the "start" square at the beginning and the "finish" square at the end of the game. In addition, the CET, entitled "Signaling Autism", has a dice numbered from 1 to 4 and the other faces of the object are constituted by "advance a house" and "pass a round without playing".

The development of the dice was thought in this way to slow down the game, since the main purpose of the game is not to get to the last square and win, but to make the players go through all the question cards and the answer cards, in order to understand all the signs and symptoms of the autistic child. Consequently, from the use of CET, parents and guardians can pay attention to a possible diagnosis of autism, seek medical help and outline, together with the qualified professionals, an adequate and individualized treatment for their child.

The board game can be played by up to three people. As previously reported, the numbered squares refer to the question square, so when the player rolls the dice and lands on one of them, they will have to take a question card referring to the number on the board, and then answer it. If the player's answer is “yes” he should continue playing, if the answer is no, it stays in the house and it will be the other player's turn.

The cards presented must be overturned during the entire match, which have a number on the back. Therefore, if the player falls on the square containing the number five (5), he must pull the question card number five (5) and the answer card of the same numbering and, thus, successively, to the “finish” square, which refers to the end of the game.

4 DISCUSSION

The CET “Signaling Autism” innovates a playful approach to care and attention focused on caregivers of autistic children, through a board game that exposes and explains the main signs and symptoms that affect the neurodevelopment of these individuals.

Initially, the proposal was to build an accessible, non-digital technology that would clearly and objectively reach the target audience. From this perspective, we thought about the board game with simple rules, as it is an interactive, current and comprehensive playful tool, since, according to Amador and Mandetta (2022), the use of playful resources favors learning and expands development of skills in search of understanding autism spectrum behaviors in a practical and enjoyable way.

The results obtained in the collection of research data, through the analysis of medical records, showed a significant prevalence of ASD in boys (16) when compared to girls (3). These data are in agreement with other studies in the scientific literature, since the incidence of autism in males is higher. This fact has some hypotheses. Research states that the diagnosis in girls occurs late, because the symptomatology of the female phenotype is often misinterpreted, leading to a false diagnosis. This may also be associated with sociocultural aspects that encompass social contexts allied to this gender, as girls are taught, from an early age, to be more behaved and restrained (Freire & Cardoso, 2022).

In many cases of autism, the first signs appear in early childhood, during the first years of life. Therefore, the appearance of these manifestations somehow impacts the daily lives and lives of family

members, as well as their relationships. Many parents report episodes of acute stress, overload and insecurities when dealing with challenging situations in daily life, as they often say they cannot understand certain actions arising from ASD (Moraes, Bialer & Lerner, 2021).

Based on these considerations, it is important to emphasize that families need a welcoming and attentive look during the diagnosis and treatment process of their autistic child. A insertion of guidance aimed at family members during these processes directly and positively leads to the improvement of the social and communicative skills of the individual with ASD, as they enable parents to adjust and adapt the socialization strategies in which the child is inserted (Oliveira, Moreira & Britto, 2021). Given these reflections, this study highlights the use of a didactic tool that signals the behavioral physiology of the autistic person. CET proposes to parents to analyze and understand their child's behaviors and the reasons why they occur.

The CET design follows standardization in the color palette. It is important to mention that there was a concern in this regard, for this reason during its construction a professional was hired to define the layout of the board game, from the presentation of the fundamental ideas of the study. Thus, clear shades were selected, with the objective that the images and text contained in the cards would be visible and more attractive to the adult audience, given that these technical and specific issues are fundamental to achieve the objective of the game (Melo et al., 2022). Health education, through the use of educational technologies, is configured as strategic instruments with great potential for coverage, capable of arousing the interest of the public on the subject, in order to facilitate the teaching and learning process (Pavinati et al., 2022).

With regard to the limitations of the study, the lack of opportunity for the application of CET with the target audience is emphasized, in order to ascertain the positive and negative points of the game and, consequently, make the necessary improvements, in order to make this instrument an important means of communication in health focused on ASD. However, this application will be carried out later, as this study will continue and the next stage of the research will be the validation of the technology. In addition, it is suggested that this game reaches other audiences, such as education and health professionals, since the theme addressed is extremely relevant for these people to better understand the autistic spectrum. Finally, it is hoped that this research will instigate the development of other technologies and other studies focused on ASD, in order to promote health education and improve the quality of life of these children.

5 CONCLUSION

The development of board games as a playful technology focused on health increases interest and facilitates learning. Under this bias, the creation of the aforementioned CET, entitled "Signaling Autism", achieved the objective of the research, as it was possible to develop an educational game aimed at the main symptoms of childhood autism, whose purpose is to alert parents and caregivers about these signs and the importance of an early and individualized diagnosis, since it will be of paramount importance for these individuals to be able to insert themselves into society and have the opportunity to enjoy their rights.

In light of these considerations, it is noteworthy that the dedication to understand this disorder and to create this game was a very learning experience, as autism is a unique disorder and each child has his vulnerabilities. However, this theme deserves to be highlighted in society so that more and more people know about ASD and its manifestations, in order to better deal with these individuals and avoid the creation of prejudiced ideas that may hurt or harm their rights as citizens.

THANKS

This work was carried out with the support of the Brazilian Hospital Services Company (EBSERH), the Júlio Bandeira de Melo University Hospital (HUJB) and the Health Information and Communication Technologies Laboratory (LATICS). The scholarship was offered through the Scientific Initiation Program (PIC/EBSERH-CNPq).

6 BIBLIOGRAPHIC REFERENCES

Amador, D. D., & Mandetta, M. A. (2022). Desenvolvimento e validação de um jogo de tabuleiro para crianças com câncer. *Revista Acta Paulista de Enfermagem*, 35, eAPE0012. https://doi.org/10.37689/acta-ape/2022AO00121.

American psychiatric association (2014). *DSM-5: Manual diagnóstico e estatístico de transtornos mentais* (5ª ed.) Editora Artmed. https://books.google.com.br/books?hl=pt-BR&lr=&id=QL4rDAAAQBAJ&oi=fnd&pg=PT13&dq=dsm+2014&ots=nR5HsJwbHY&sig=owx-hdCgIRsLLgza3obJSbjRmFY#v=onepage&q=dsm%202014&f=false.

André, T. G., Montero, C. V., Félix, R. E. O., & Medina, M. E. G. (2020). Prevalencia del transtorno del espectro autista: una revisión de la literatura. *Revista Jóvenes em la ciência*, 7. https://www.jovenesenlaciencia.ugto.mx/index.php/jovenesenlaciencia/article/view/3204.

Dados e estatísticas sobre transtorno do espectro do autismo. (2020). *Centers for Disease Control and Prevention*. https://www.cdc.gov/.

Freire, J. M. de S., & Nogueira, G. S. (2023). Considerações sobre a prevalência do autismo no brasil:uma reflexão sobre inclusão e políticas públicas. *Revista foco*, 16(3), e1225-e1225. https://doi.org/10.54751/revistafoco.v16n3-009.

Freire, M. G., & Cardoso, H. dos S. P. Diagnóstico do autismo em meninas: revisão sistemática.

Revista Psicopedagogia, 39(120), 435-44. https://cdn.publisher.gn1.link/revistapsicopedagogia.com.br/pdf/v39n120a13.pdf.

Hofzmann, R. da R., Perondi, M., Menegaz, J., Lopes, S. G. R., & Borges, D. da S. (2019). Experiência dos familiares no convívio de crianças com transtorno do espectro autista (TEA). *RevistaEnfermagem em foco*, 10(2), 64-69. https://doi.org/10.21675/2357-707X.2019.v10.n2.1671.

Homercher, B. M., Peres, L. S., Arruda, L. F. dos S., & Smeha, L. N. (2020). Observação materna: Primeiros sinais do Transtorno do Espectro Autista Maternal. *Revista Estudos e Pesquisas em Psicologia*, 20(2), 540-558. https://www.redalyc.org/articulo.oa?id=451866262009.

Kim, N., Choi, U. S., Ha, S., Lee, S. B., Song, S. H., Song, D. H., & Cheon, K. A. (2018). Aberrant neural activation underlying idiom comprehension in Korean children with high functioning autism spectrum disorder. *Yonsei medical journal*, 59(7), 897-903. https://doi.org/10.3349/ymj.2018.59.7.897.

Macedo, L. M. de., Medeiros, J. H. B. de., Oliveira, F. H. L. de., Esmeraldo, L. F., Macedo, A. G. M. de.,& Nobre, M. E. P. (2021). Alterações fisiológicas durante período pré-natal predisponentes ao Transtorno do Espectro Autista: Uma Revisão Sistemática. *Revista Multidisciplinar e de psicologia*, 15(55), 485-504. https://doi.org/10.14295/idonline.v15i55.3088.

Maciel, M. P. R., Costa, L. M. A., Sousa, K. H. J. F., Oliveira, A. D. da S., Amorim, F. C. M., Moura, L. K.B., Zeitoune, R. S. G., & Almeida, C. A. P L. (2022). Construção e validação do jogo educativo sobre a infecção pelo papilomavírus humano. *Revista Acta Paulista de Enfermagem*, 35, eAPE03012. http://dx.doi.org/10.37689/acta-ape/2022AO03012.

Madra, M., Ringel, R., & Margolis, K. G. (2020). Gastrointestinal issues and autism spectrum disorder. *Child and adolescent psychiatric clinics of North America*, 29(3), 501-513.

Magagnin, T., Silva, M. A. da., Nunes, R. Z. de S., Ferraz, F., & Soratto, J. (2021). *Physis: Revista de Saúde Coletiva*, 31(1), e310104. http://dx.doi.org/10.1590/S0103-73312021310104.

Mapelli, L. D., Barbieri, M. C., Castro, G. V. D. Z. B., Bonelli, M. A., Wernet, M., & Dupas, G. (2018). Criança com transtorno do espectro autista: cuidado na perspectiva familiar. *Revista Escola Anna Nery*, 22(4), e20180116. https://doi.org/10.1590/2177-9465-EAN-2018-0116.

Martins, F. C. R. M., Machado, F. P., da Silva, C. S. R., & Palladino, R. R. R. (2021). Childhood apraxia of speech evaluation in autism spectrum disorders: three clinical cases report. *ABCS Health Sciences*, *46*, e021401-e021401. https://doi.org/10.7322/abcshs.2019165.1434.

Melo, P. de O. C., Abreu, W. J. C de., Feitoza, A. R., Barbosa, A. S., Mendes, R. C. M. G., Teixeira, E., & Guedes, T. G. (2022). Jogo de tabuleiro como dispositivo de informação sobre hiv/aids para idosos. *Revista Cogitare Enfermagem*, 27, e79013. http://dx.doi.org/10.5380/ce.v27i0.79013.

Moraes, A. V. P. M., Bialer, M. M., & Lerner, R. (2021). Clínica e pesquisa do autismo: olhar ético para o sofrimento da família. *Revista Psicologia em Estudo*, 26, e48763. https://doi.org/10.4025/psicolestud.v26i0.48763.

Möricke, E., Greven, C. U., Visser, J. C., Oosterling, I. J., Buitelaar, J. K., & Rommelse, N. N. (2019). Social-communicative and attention problems in infancy and toddlerhood as precursors of preschool autistic traits. *ADHD Attention Deficit and Hyperactivity Disorders*, 11, 113-122. https://doi.org/10.1007/s12402-018-00284-2.

Oliveira, J. J. R. de., Moreira, I. A., & Britto, D. B. de O. Benefícios da orientação familiar nas dificuldades comunicativas de crianças com transtornos do espectro do autismo: revisão integrativa da literatura. *Revista Distúrbios da Comunicação*, 34(1), e53197, 2022.

Orrú, S. E. (2020). Singularidades e impacto social del autismo severo en Brasil. *Revista Humanidades Médicas*, 20 (2). https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=95867.

Pavinati, G., Lima, L. V. de., Soares, J. P. R., Nogueira, I. S., Jaques, A. E., & Baldissera, V. D. A. (2022) Tecnologias educacionais para o desenvolvimento de educação na saúde: Uma revisão integrativa. *Arquivos de Ciências da Saúde da UNIPAR*, 26(3), 328-349. https://doi.org/10.25110/arqsaude.v26i3.2022.8844.

Prodanov, C. C., Freitas, E. C. de. (2013). *Metodologia do trabalho científico: métodos e técnicas da pesquisa e do trabalho acadêmico* (2ª ed.). Editora Feevale. https://books.google.com.br/books?hl=pt-BR&lr=&id=zUDsAQAAQBAJ&oi=fnd&pg=PA13&dq=prodanov+e+freitas+2013&ots=dc359ky6DJ&sig=MemZDn4RAMHTBQ5r_hGbWk_SL1M#v=onepage&q=prodanov%20e%20freitas%2013&f=false.

Rocha, C. C., Souza, S. M. V. de., Costa, A. F., & Portes, J. R. M. (2019). O perfil da população infantilcom suspeita de diagnóstico de transtorno do espectro autista atendida por um Centro Especializado em Reabilitação de uma cidade do Sul do Brasil. *Physis: Revista de Saúde Coletiva*, *29*(4), e290412. http://dx.doi.org/10.1590/S0103-73312019290412.

Sousa, A. de J., Rodrigues, M. C. N., & Santos, T. B. dos. (2022). A importância da ludicidade no processo de aprendizagem do aluno com transtorno do espectro autismo-TEA. In: F. H. P S. de.*Os desafios das políticas sociais, inclusão e o trabalho em rede na promoção da qualidade de vida*. Editora Epitaya. https://doi.org/10.47879/ed.ep.2022380p55.

Souza, A. B., Meurer, L. de M., & Cymrot, R. (2021). Avaliação do desenvolvimento infantil de crianças com suspeita de perturbação do espectro autista. *Millenium*, *2*(16), 31-38. https://doi.org/10.29352/mill0216.24854.

Zepponi, K. M. C., Bracialli, L. A. D., & Pinheiro, O. L. (2021). Validação de jogos educativos em farmacologia. *Revista Pesquisa Qualitativa*, 9(21), 410-423, 2021. http://dx.doi.org/10.33361/RPQ.2021.v.9.n.21.455.

COMO CITAR ESTE ARTIGO:
Barbosa de Freitas, L., Ferreira Lima Júnior, J., Cristina de Abreu Temoteo, R., & Carvalho Benitez, L. (2024). DESENVOLVIMENTO DE UMA TECNOLOGIA EDUCACIONAL PARA DETECTAR ALTERAÇÕES FISIOLÓGICAS NO AUTISMO INFANTIL. HOLOS, 2(40). https://doi.org/10.15628/holos.2024.16817.

SOBRE OS AUTORES

LARISSA BARBOSA DE FREITAS
Universidade Federal de Campina Grande. Licenciada em Ciências Biológicas, pela Universidade Federal de Campina Grande (UFCG). Mestranda em Ciências Morfofuncionais, pela Faculdade de Medicina da Universidade Federal do Ceará (UFC). Pós-graduanda em Docência do Ensino Superior (lato sensu), pelo Instituto Federal de Educação, Ciência e Tecnologia do Ceará (IFCE) e em Educação Especial na Perspectiva da Educação Inclusiva (lato sensu), pelo Instituto Federal de Roraima (IFRR). Atuou como Bolsista em Programas de Iniciação Científica e de Docência (PIC/EBSERH e PIBID). Possui experiência na área de desenvolvimento de tecnologias educacionais.
E-mail: larissabfreitas19@gmail.com
ORCID-ID: https://orcid.org/0000-0002-6742-3505

JOSÉ FERREIRA LIMA JÚNIOR
Universidade Federal de Campina Grande. Possui graduação em Odontologia pela Universidade Federal do Rio Grande do Norte (UFRN) (2003); título de especialista em Saúde Coletiva pelo Conselho Federal de Odontologia (2006); especialista em Formação de Professores para o Ensino Superior (2008); mestrado em Odontologia Preventiva e Social / Saúde Coletiva pela UFRN (2005) e doutorado em Biotecnologia em Saúde pela Universidade Federal da Paraíba - UFPB (2012). É docente da Escola Técnica de Saúde de Cajazeiras da Universidade Federal de Campina Grande (UFCG), tendo sido concursado para a área de Saúde Coletiva e concluiu estágio Pós-Doutoral junto ao Programa de Pós-graduação em Desenvolvimento Regional Sustentável (PRODER) da Universidade Federal do Cariri (UFCA) em 2016.
E-mail: jose.lima@professor.ufcg.edu.br
ORCID-ID: https://orcid.org/0000-0002-5571-4989

RAYRLA CRISTINA DE ABREU TEMOTEO
Universidade Federal de Campina Grande. Professora na Escola Técnica de Saúde de Cajazeiras (ETSC/UFCG). Foi docente no Instituto Federal da Paraíba (IFPB, Campus Avançado João Pessoa Mangabeira). Doutora em Enfermagem - Universidade Federal do Rio Grande do Norte - UFRN (Área de concentração ? Enfermagem na Atenção à Saúde). Mestra em Saúde Pública pela Universidade Estadual da Paraíba - UEPB, vinculado ao Programa de Pós-Graduação em Saúde Pública.
E-mail: rayrlacz@hotmail.com
ORCID-ID: https://orcid.org/0000-0003-1980-7819

LETÍCIA CARVALHO BENITEZ
Universidade Federal de Campina Grande. Possui graduação em Ciências Biológicas pela Universidade da Região da Campanha (2004), mestrado em Fisiologia Vegetal pela Universidade Federal de Pelotas (2008) e doutorado em Fisiologia Vegetal pela mesma Instituição (2012). Durante o período de doutorado desenvolveu parte dos trabalhos de tese na Escuela Técnica Superior de Ingenieros Agrônomos (E.T.S.I.A) da Universidad Politécnica de Madrid/Espaa (UPM), em estágio sanduíche PDEE (CAPES). Foi bolsista de Pós-Doutorado no Programa de Pós-Graduação em Fisiologia Vegetal/UFPel pela modalidade DOCFIX - CAPES/FAPERGS. Atualmente é Professora do Magistério Superior da Unidade Acadêmica de Ciências Exatas e da Natureza (UACEN) do Centro de Formação de Professores (UFCG) da Universidade Federal de Campina Grande (UFCG). Durante a Pós graduação adquiriu experiência em pesquisas nas áreas de Fisiologia Vegetal, Ecofisiologia, Biologia Molecular e Biotecnologia Vegetal, atuando, principalmente, nas temáticas de

estresse abiótico, estresse oxidativo, caracterização morfológica e molecular de plantas para tolerância a estresses e expressão gênica diferencial. Atualmente, vem desenvolvendo, também, projetos voltados para a caraterização fitoquímica e atividade biológica in vitro e in vivo de plantas medicinais. Desde agosto de 2021 é Coordenadora do Curso de Licenciatura em Ciências Biológicas do CFP/UFCG.
E-mail: leticia.carvalho@professor.ufcg.edu.br
ORCID-ID: https://orcid.org/0000-0002-5900-1193

Editora Responsável: Maura Costa

Submetido 12/08/2024
Aceito 18/09/2024
Publicado 12/11/2024