ADHD IN BASIC EDUCATION: AN ANALYSIS OF TRADITIONAL AND DIGITAL GAMES FROM THE NEUROSCIENTIFIC PERSPECTIVE OF LEARNING

TDAH NA EDUCAÇÃO BÁSICA: UMA ANÁLISE DE JOGOS TRADICIONAIS E DIGITAIS NA PERSPECTIVA NEUROCIENTIFICA DA APRENDIZAGEM

TDAH EN EDUCACIÓN BÁSICA: UN ANÁLISIS DE LOS JUEGOS TRADICIONALES Y DIGITALES DESDE LA PERSPECTIVA NEUROCIENTÍFICA DEL APRENDIZAJE

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ABSTRACT

This empirical study, based on descriptive qualitative methodology, aims to analyze the use of traditional and digital games in the teaching-learning process of children with Attention Deficit Hyperactivity Disorder (ADHD), from a neuroscience perspective. The research seeks to understand how these playful tools can serve as complementary resources to psychopedagogical assessment and assist in addressing the educational challenges posed by ADHD in Basic Education. An intervention proposal was developed with teachers, focusing on teaching practices aimed at students showing signs of hyperactivity and inattention. The results reveal that the lack of specific training for teachers to work with this population contributes to increased professional stress and student academic failure, highlighting the urgent need for neuroscientifically grounded pedagogical strategies capable of promoting inclusion and academic success.

Keywords: ADHD. School Inclusion. Neuroscience of Learning. Traditional and Digital Games. Teacher Training.

RESUMO

Este estudo, de caráter empírico e baseado em metodologia qualitativa descritiva, tem como objetivo analisar o uso de jogos tradicionais e digitais no processo de ensino-aprendizagem de crianças com Transtorno de Déficit de Atenção e Hiperatividade (TDAH), sob a perspectiva da neurociência. A pesquisa busca compreender como essas ferramentas lúdicas podem servir como recursos complementares à avaliação psicopedagógica e auxiliar no enfrentamento dos desafios educacionais impostos pelo TDAH na Educação Básica. Foi desenvolvida uma proposta de intervenção junto a professores, com foco em práticas didáticas voltadas a estudantes que apresentam sinais de hiperatividade e desatenção. Os resultados revelam que a ausência de formação específica dos docentes para atuar com esse público contribui para o aumento do estresse profissional e para o fracasso escolar dos alunos, evidenciando a urgência de estratégias pedagógicas neuro cientificamente fundamentadas, capazes de promover a inclusão e o sucesso acadêmico.

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Palavras-chave: TDAH. Inclusão Escolar. Neurociência da Aprendizagem. Jogos Tradicionais e Digitais. Formação Docente.

RESUMEN

Este estudio empírico, basado en una metodología cualitativa descriptiva, tiene como objetivo analizar el uso de juegos tradicionales y digitales en el proceso de enseñanza-aprendizaje de niños con Trastorno por Déficit de Atención e Hiperactividad (TDAH), desde la perspectiva de la neurociencia. La investigación busca comprender cómo estas herramientas lúdicas pueden servir como recursos complementarios para la evaluación psicopedagógica y ayudar a afrontar los desafíos educativos que impone el TDAH en la Educación Básica. Se elaboró una propuesta de intervención con docentes, enfocada en prácticas docentes dirigidas a estudiantes que presentan signos de hiperactividad e inatención. Los resultados revelan que la falta de formación específica del profesorado para trabajar con esta población contribuye al aumento del estrés profesional y del fracaso académico estudiantil, poniendo de relieve la urgencia de estrategias pedagógicas con base neurocientífica capaces de promover la inclusión y el éxito académico.

Palabras clave: TDAH. Inclusión Escolar. Neurociencia del Aprendizaje. Juegos Tradicionales y Digitales. Formación de Profesores.

1 INTRODUCTION

This chapter of the book presents a research developed as a study of teacher training taking into account legal aspects and the theoretical and social relevance of the study. The choice of the theme is justified from the personal, academic and social aspects considering that since 2018, Graduate Programs at UFMA (Federal University of Maranhão) and UEMA (State University of Maranhão), have been carrying out research and group study orientations on teaching and research activities in Public Schools in Maranhão.

The intention through this research was to develop theoretical-methodological procedures for the continuous training of professionals capable of developing specific knowledge, skills and abilities in the areas of Inclusive Teaching in Basic Education. With this in mind, the Programs encourage and promote actions that can expand the interaction of graduate students, especially in master's degrees where most students are professors.

This study sought to develop procedures that make it possible to identify teachers' understanding of the use of Neurosciences by offering a deep insight into the brain processes involved in learning. In this understanding, it provides valuable insights for educators and students on how the brain works and adapts, which is crucial to improve educational practices and create more effective learning environments and contribute to the creation of more favorable conditions for pedagogical practice.

Regarding this approach, it was perceived the need to increasingly seek the insertion of this knowledge in school environments as a field of intersection that integrates knowledge, seeking to favor learning, through the adaptation of conventional teaching methods incorporating approaches based on brain functioning in support of the teaching of students with signs of ADHD. To this end, it demonstrates the use of traditional rules games and in electronic format

Regarding the justification of this research, the interest in this theme is also focused as a result of several researches carried out by the authors in relation to it, being notorious the problems that increase in the current context in various social spaces and especially in the school environment, due to the absence of continuing education to train teachers to deal with ADHD. This aspect is significant for the occurrence of this study, in the interest of participating in the development of learning in students with ADHD, understanding limits, challenges, possibilities and difficulties resulting from this disorder.

It is evident that despite the significant presence of ADHD in the school context, where there is considerable development of scientific research, there is still a lack of knowledge among teachers (Silveira, 2024; Saints; Silveira, *et al.* 2025). The implications related to

inclusive education have been much discussed in the research of master's students, but what has been found in regular schools, in general, is an exclusionary education process.

Normally, when a student with signs of ADHD is placed in a classroom in regular education, in public education institutions, he is restricted to the condition of "inattentive and undisciplined student", since he is not allowed to learn differently according to his condition. This is because in most cases teachers have not been prepared and trained to adapt teaching to these particular cases. In view of the foregoing, this research sought to understand how neuroscience applied to the teaching of children with ADHD can offer quality in learning with the use of technologies, as complementary instruments in school teaching,

Neuroscience is essential to help understand the best learning of children with signs of ADHD, as it demonstrates the scientific study of the nervous system, covering its structure, function, development, alterations and relationship with behavior and cognition. It is a multidisciplinary area that integrates knowledge from different areas, such as biology, chemistry, psychology, education, medicine and computer science, to investigate the nervous system at different levels, from the molecular to the behavioral. Thus, it is important to have this scientific knowledge to understand the brain of children with ADHD and especially how this child learns, in order to improve their learning development at school.

Attention deficit hyperactivity disorder (ADHD) is characterized as a neurodevelopmental disorder, being characterized by behaviors of inattention, hyperactivity, and impulsivity. This condition is classified into three aspects: inattentive, hyperactive-impulsive and combined, affecting executive functions (EF) in different ways. DSM-5-TR (2023). When these functions are compromised, which are responsible for any and all learning, they will impact areas responsible for the organization of tasks, in the fulfillment of objectives, such as the difficulty in maintaining focus, and may often present inhibitory behaviors that affect the cognitive process and social and academic performance.

The Legislation and Public Policies (Brazilian Law of Inclusion) (LBI) and the National Policy on Special Education (PNEE) aim to ensure the inclusion of all students. But there are still adequate structural challenges and resources. The Brazilian Inclusion Law (LBI) of 2015 was an important milestone, guaranteeing the right to inclusive education for all children and adolescents with disabilities. there has been an increase in the number of adapted schools and in teacher training in Brazil, with public policies that promote digital inclusion, facilitating access to education for all.

However, only Law No. 14,254, of November 30, 2021, provides for comprehensive monitoring for students with dyslexia or Attention Deficit Hyperactivity Disorder (ADHD) or other learning disorder.

Attention Deficit Hyperactivity Disorder (ADHD), manifests itself through inappropriate symptoms of inattention, hyperactivity and impulsivity, manifests itself in two or more different contexts (home, school or work), presenting signs in early childhood and these symptoms become more evident when approaching pre-adolescence, according to the diagnostic criteria of the DSM-5-TR (2023) It is maintained throughout adolescence and adulthood in 65% of people.

ADHD is characterized by deficits in executive functions (organization, planning, mental flexibility), attention, and memory already well established in adults with the disorder. This disorder is socially significant, being one of the most well-known diagnoses in the school environment, characterized as one of the most frequent problems of childhood mental disorder. Countless children diagnosed with this disorder have educational and social difficulties, among other cognitive impairments. Thus, ADHD is considered one of the high individual and social costs for the population (Rosa, Lacet, 2017).

The main executive functions (EF) for neuroscience are related to response inhibition, working memory and cognitive flexibility. Thus, through this investigation, it is sought to understand the role of (EF) in individuals with ADHD, aiming to develop activities that explore actions based on the results of studies in the area of neuroscience for classroom intervention with children belonging to this group.

Neuroscience is of essential importance in the development of research in various areas of the human brain. Explaining how the brain works, from the most basic levels, such as neurotransmitters and synapses, to the most complex cognitive processes, such as memory, emotion, and decision-making. Some fields of neuroscience studies stand out, such as understanding the functionality of the Human Brain, offering a deeper understanding of the structure and function of the human brain. It is essential for us to understand how we think, feel, behave, and how we interact with the world around us.

In the teaching of children with ADHD, neuroscience has been contributing significantly in several ways, especially with research that demonstrates the understanding of how the brain mechanism works to favor the learning of children with this disorder. In this sense, we had the opportunity to be able to assist in research by education professionals, such as teachers, school psychologists and pedagogues, after understanding the functionality of the brain of the child who has ADHD, with this knowledge it was possible to intervene in teaching and learning in a more objective way, providing direct the child's attention to the focus of school activity, awakening their interest in learning.

The interest of the child with ADHD in routine classroom activities requires motivational adjustments on the part of the teacher, learning occurs when adaptations in the content are

used in the classroom during class, examples are demonstrated with colorful images, drawings, movements and/or sounds that awaken in this student the attention to the focus of teaching, the lack of focus of this student is due to his characteristics of hyperactivity or impulsivity, but when visualizing movements and colors, what the teacher is explaining makes more sense to him, awakening him and stimulating him cognitively to understand the context of the teaching presented there.

The knowledge of neuroscience in pedagogical practice through multifaceted and interactive games, with colors and images are significant to favor a more motivating class, providing better learning, through stimulation of cognitive functions, in order to focus the attention of the child with ADHD, to obtain greater interaction with the didactic contents and school context, enabling an approximate leveling of learning with the development of the other students present in the classroom.

The teachers were guided about some mechanisms, using neuroscience. To favor better learning of children with signs of ADHD, games were tested as teaching tools, such as operative tests and rule games in classic and computerized versions. These strategies currently emerge as a theme in the Brazilian literature as possible alternatives of complementary instruments to carry out observations in the classroom (Missawa, Rossetti, 2008; Folquito, 2009; Alves, Carvalho, 2010; Ogioni, 2011).

This research aroused the interest of contributing to quality education in public schools in Maranhão, helping through interactive activities as tools the teaching of students with ADHD, seeking to enable teachers to develop strategies to include these students, adapting them to a curriculum that would meet their learning needs.

It is common in some schools for teachers to report students with ADHD in basic education that they have not yet been literate because they are restricted to the condition of "agitated and unconcentrated student", a fact that tends to be presented by the absence of resources adapted to their condition, by the teacher's lack of technical knowledge, by the absence of a diagnosis and by the teacher's lack of information so that they can guide with a focus on the student's condition in the School.

The central issues that were streamlined in these studies refer to the production of materials adapted through the knowledge of neuroscience and with efficient and economical teaching procedures, which can promptly promote the learning of students diagnosed with ADHD. It was possible to start a small advance in training for Special Education teachers in Basic Education in the State of Maranhão, through our advisees in this specialty, through their academic research.

It is understood that these actions can represent the adoption of strategies and a safe way to prevent and reverse school failure, both for the context of ADHD children and for other children, in addition to teachers. In this way, these actions can become a continuous act through university extension projects, expanding the offer of services to other educational institutions, which also present this difficulty.

In this context, this training period allowed the authors of this proposal to take a deep dive and focus on actions that provided the development of specific skills and abilities. In this context, it made it possible to meet the institutional demands regarding the professional training of students of the Psychology Course at UFMA, to develop specific procedures and materials that will serve a segment of society, as well as to respond to the institutional desires regarding the production of projects that could favor the curriculum of the extension activities of the course.

As a general objective, it was investigated the application of neuroscience and the use of technologies as complementary instruments for psychopedagogical assessment and in the teaching of children with ADHD, in municipal and community public schools in the State of Maranhão. Thus, the following specific objectives were developed: We began to understand the role of executive functions in individuals with ADHD and explore actions based on the results of studies in the field of neuroscience for intervention in school teaching; The understanding of teachers in relation to the experiment of traditional and electronic rule games in support of the teaching of students with signs of ADHD was identified.

During the development of the research, it was possible to train a group of psychology students how to identify students with signs of ADHD through an anamnesis and the screening instruments SNAP-IV, CPT II and the ADHD-II – Attention Deficit Hyperactivity Disorder Scale, being included as participants in the research in order to form a research team. Classical operative tests and computerized versions were applied as complementary evaluation instruments to some students who volunteered and who showed signs of ADHD; There was a convergence between the results obtained, using traditional instruments to assess signs of ADHD and the new instruments proposed, which signaled some favorable aspects in the evaluation, simplifying the process.

During the Methodological process, the research and training activities, in short, all work plans, were carried out in a laboratory of UEMA, under the supervision of the research project advisor. The sample for the pilot study consisted of the voluntary collaboration of five teachers and 10 students with ADHD in the age group of 9 to 11 years belonging to a community school.

A favorable and welcoming physical space was made available by the university for the operational development of the proposed activities. Being the place for the planning of training activities under the supervision and collaboration of the advisor, in the Teaching Laboratory of the Center for Education and Natural Sciences (CECEN) at the State University of Maranhão, in the city of São Luís-MA.

The ethical criteria for conducting the research were established after being accepted by the University's research ethics committee. It is important to state that during these three months we did an initial part of surveying and systematizing the demands, but the research will continue with a more significant sample, in the sense of observing and analyzing results, but robust, addressing the evaluation of children in two other modalities to make pairings and carry out continuous training with all teachers, continuing the study started. This time research was being carried out specifically in the Schools.

The activities carried out during the research concern the face-to-face participation in the Study Group coordinated by the advisor professor, GEPS. The core of this research is related to the construction of alternative teaching procedures, especially with regard to the development of teaching methodology. In this way it was possible to survey bibliographic references, elaborate the State of the Art Study of the general theme of the problem; carry out the survey and systematization of the demand of the Schools; organize the material for the execution of the Workshops.

Activities such as lectures were held in the Study Group, reading and discussion of text. The workshops for the development of procedures and programming of the instruments developed for the study also took place during the study group meetings, in addition to the evaluation and discussion of the results, with adjustment in the procedures and proposed instruments; preparation and submission of an article with systematization and evaluation of the results.

For the research, viable, economical and attractive alternatives were sought for these students. The instruments used were the anamnesis script, SNAP IV, CPT II and ETDAH-II - Attention-Deficit/Hyperactivity Disorder Scale, classic operative tests, traditional rule games and electronic games. It was intended to propose new and more accessible instruments as complementary tools in evaluation. The use of classic tests aims to make comparisons with electronic games in order to verify the feasibility of evaluation with games and to offer greater security in the results. Didactic-pedagogical resources, when used properly, become fundamental tools in the teaching-learning relationship.

In the education of people with ADHD, the adapted use of these resources becomes essential. It is understood that this importance occurs because one of the basic problems of

these students is the difficulty of social interaction and adaptation to the physical environment, in addition to the lack of specific material used in regular education that can help these students in their learning at a time without sufficient cognitive stimulation to meet their need. Without a concrete connection with their reality, since for the creation of concepts, the child needs to get in touch with interactional stimuli, training their tactile, visual and sound articulation perception, providing the discrimination of details, which is facilitated by the handling of different materials (Silveira, 2022).

2 FINDINGS

The expected result in the training period refers to the development of alternative instrument procedures for teaching people with ADHD. The "interactive games workshop" for ADHD was an interest of both the proponent and the school community. The practical relevance of this action is invaluable for this segment. Therefore, in addition to structuring the design for the activities, it was also transformed into a continuous act through an Extension Project that we applied in the Schools.

The results of the "interactive games workshop" action enabled an unexpected involvement with continuous activities and the creation of various interactive instruments, such as drawings for checkers, soccer courts for button games and drawings for chess games, which after the drawings. They glued them to plywood planks, for better use. They were used in sequence by the students, because games such as chess, checkers and button football could be very beneficial for people with ADHD, as it was found that it stimulates attention, logical reasoning, concentration and planning, in addition to promoting socialization and self-esteem.

During the visits of the schools, it was suggested to the teachers of the visited schools to indicate children with signs of ADHD. These students participated in the pilot research.

The elaboration of alternative instruments for the teaching of people with ADHD, as already discussed, the "interactive games workshop" for ADHDs was of interest to both the proponent and the school community. The practical relevance of this action was invaluable for this segment. In addition to structuring the outline for the activity, it is expected to transform it into a continuous act through an Extension Project.

The results of the activities developed in this training aiming at the elaboration of activities for the School environment, enables an approximation with academic subunits and the Department of Psychology / UFMA and PPG UEMA) that may constitute, in the not too distant future, spaces of extension practices for students of the Psychology Course at UFMA.

It is noteworthy that all the outlined objectives were met during the application of the research, the proposal was presented to the school community, we did a training applying the procedures and instruments built, presenting significant results for the study proposal. We started with the evaluation of children with signs of ADHD, we did anamnesis with the presence of the mothers who signed the free and informed consent form before the experiments. The necessary screening instruments were applied, the SNAP-IV Test - where the symptoms of inattention and hyperactivity were evaluated. CPT II – which is a validated measure of attention or sustained vigilance, in which a computer button is pressed when the child sees or hears a specific word or image, and the ADHD-II – Attention-Deficit/Hyperactivity Disorder Scale, aims to recognize the manifestation of ADHD signs in the school environment, considering the teacher as a source of data; in addition to evaluating and enhancing possible impairments associated with the areas of attention, hyperactivity/impulsivity, academic performance (school performance and difficulties in school skills) and social functioning (interpersonal relationships and social skills).

The results of the tests showed indications for ADHD, with significant rates in all children indicated to participate in the research.

The evaluation continued with the application of the experiments in the interactive games workshop, in which they were significant, so that the participants will have motivation to participate in addition to being clearly perceived the expected benefits such as stimulation and focus on attention, so that they demonstrated good logical reasoning in the constructions of the games, concentrated on the tasks and planning their constructions, in addition to promoting socialization in the group and self-esteem, being clearly perceived through expressions of joy and interactive communications during the performance of tasks.

The application of the classic operative tests had Piaget as its main reference, as it evaluates the cognitive development of children. The traditional rules games were applied, the Hopscotch Game (Game in which a path is drawn on the ground and jumps in each square) and the Marbles (Game in which marbles are thrown to hit others or to reach certain points drawn in the space used for the game, following specific rules), were used. in addition to the use of electronic games.

New and more accessible instruments were made possible as complementary tools in evaluation. The use of the classic tests was intended to make comparisons with electronic games (for this game the application "the fun multiplication table" was used). When making comparisons between these two games in order to verify the feasibility of evaluating the results, it was observed that the results were divergent, in the traditional games the children were involved in interaction, competition, communication and reacted in a more fun way,

gesticulating and talking about the success between them, it was observed that the traditional game promoted the integral development of the children, encompassing physical, social, emotional and cognitive aspects. In addition to socialization, learning rules, motor development and creativity. The results in the electronic game "Fun Times Table", which required more attention from the children, kept them focused on the screen, leaving them concentrated, made the learning of the multiplication table more fun and effective, helping in the memorization and fixation of the results of mathematical operations, being able to stimulate logical reasoning, developed concentration and improved mental calculation, however there was no social interaction and made the children more anxious and dispersed at the end. It is concluded about electronic games that it is still necessary to make diversified selections to obtain different results in order to help the child in his learning. In general, the results were expressive and facilitated the understanding and validity of the games for the school development process.

As for the training of the five teachers, an interview was initially applied to learn about the main challenges and perspectives of teachers in teaching children with ADHD, which was very fruitful. Afterwards, a presentation was given on the impacts of ADHD on learning, focusing on the following topics: 1. Concepts. 2. Signs, causes and characteristics of ADHD. 3. Attention difficulties in maintaining focus for prolonged periods, which can lead to the loss of important information during classes. 4. Inattention, boredom, anxiety, lack of interaction, disorganization, and incompletion of tasks. 5. Impulsivity and hyperactivity in these children. 6. What to do to change this context and what not to do in the classroom. 7. What is problem behavior. 8. How to use the behavioral approach when creating rules for changing the child's behavior with a focus on learning. 9. The study of neuroscience and the importance of knowledge about brain functions and the process for learning in children with ADHD.

The entire training was interactive and at the end, the teachers were asked to evaluate the training, who issued their opinions and impressions. The results of the teachers' evaluations were motivating, as they reported how much they learned and some wrote that they left more oriented, that from this event they would know the path to follow with their ADHD students. In general, they stated the significant importance in understanding the disorder and how to work in the classroom after graduation.

3 CONCLUSION

It is concluded that the observations of ADHD in basic education, through an analysis of traditional and digital games in the neuroscientific perspective of learning applied to the teaching of children with ADHD, were significant for the understanding and implementation

of all the research carried out, contributing in several ways, especially in the preparation of teacher training, making it possible to demonstrate the understanding of how the mechanisms of the brain work to favor the learning of children with disabilities. Attention Deficit Hyperactivity Disorder (ADHD). In this sense, surely the entire group of teachers understood the need to read more about neuroscience and its actions related to the learning of children with ADHD and other disorders, in order to facilitate the understanding of the inclusive student in the school context.

The question about the importance of neuroscience applied to the teaching of children with ADHD and the use of interactive games as complementary instruments in school teaching was clearly answered in this study, with the explanation of teacher training and the practical application with visual actions, demonstrated through technologies involving applications with interactive games specialized in learning in education, traditional games and the construction of interactive game workshops, which enabled greater understanding. The involvement of teachers with the instruments used there with the children, aroused interest and clarity to be used in the School, as mechanisms of facilitated learning and an evaluation within the expected proposal.

Through the research it was possible to know the problems and challenges faced by teachers, with the ADHD student in the classroom. In this way, the teachers, by focusing on their challenges, explored the possibilities in the performance of specialized teaching to obtain learning by children. The proposal of pedagogical intervention was carried out with the teachers, in a way that enabled them to verify the didactic performance with students who present signs of ADHD.

There was the interpretation of the teachers, that the impotence due to the lack of scientific knowledge to teach these children correctly, really causes stress in the teacher, the knowledge of necessary actions, would avoid resulting in the student with ADHD school failure.

It is noteworthy that, in general, the results were expressive. We focus on the fact that one of the main academic goals of a teacher, after completing a study, is to write and publish the results of the study in an indexed journal, contributing to the production of new knowledge within their area of investigation and field of activity, it is believed that this research offered data to teachers to verify the potential importance that the knowledge of neuroscience applied to the teaching of children with ADHD has, in addition to arousing the interest of the authors for other related studies, using a larger sample. The analysis of this research was significant to guide the idea of applying this study with a more expressive sample.

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