

Educational Robotics And The Autistic Spectrum Disorder: A Systematic Literature Review

Francisco Antonio Nascimento, Tarcisio Ferreira Cavalcante¹, Adaldécio Machado dos Santos², Anselmo Ferreira dos Santos³, Gleison Costa Ramos⁴, Carlos Alberto Feitosa dos Santos⁵, Ricardo Santos de Almeida⁶, Gustavo Bohnenberger⁷.

Universidade Federal do Ceará (UFC) – Brasil)

¹*(Universidade de Brasília – UnB-Brasil)*

²*(Universidade Alto do Vale do Rio Verde (UNIARP) – Brasil)*

³*(Instituto Federal de Educação, Ciência e Tecnologia do Amazonas –IFAM – Campus Maués- Brasil)*

⁴*(Universidade Federal de Rondônia - UNIR, Brasil)*

⁵*(Universidade Ibirapuera – UNIB - Brasil)*

⁶*(Universidade Federal de Santa Maria – UFSM – Brasil)*

⁷*(Pontifícia Universidade Católica do Rio Grande do Sul – PUCR- RS, Brasil)*

Abstract:

Nowadays It Is Common To Use New Technologies In The School Environment. Among These, There Is, For Example, The Use Of Robotics As A Teaching Methodology, Which Can Contribute To The Development Of Logical Thinking, Problem Solving, Hypothesis Generation, Elaboration Of Solution Strategies, Communication, And Also Socialization. Another Reality That Concerns Schools Today Is The Significant Increase In The Number Of Diagnoses Of Children With Autism Spectrum Disorder. This Means That Educators Need To Be Prepared To Work With These Children In Order To Promote Their Learning And Inclusion. Thus, This Article Of Systematic Literature Review Seeks To Highlight, Through A Survey Of Scientific Papers In Portuguese And English, How The School Environment Is Conducive To Working With Robotics, Especially With Autistic Children. As A Result, Through The Analyzed Studies, It Was Perceived That Robotics Can Contribute To The Development Of Social Skills In Students With ASD And Other Skills In General.

Key Word: Robotics. School. TEA.

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I. Introduction

The use of technologies in the school environment has become increasingly recommended. This is due to the interest aroused in children and adolescents and the social pressure for students to be inserted in contemporary society, which is increasingly influenced by technological instruments. This discussion has reached schools through different subjects, which demands that teachers and researchers study the use of these technologies in the school environment. One of the subjects that has gained prominence recently is educational robotics (PEDROSA; CALDEIRA; MATOS, 2022).

The use of technologies, according to Pedrosa, Caldeira and Matos (2022), in education is of extreme importance today. Through them, it is possible to provide a more dynamic learning environment, interactive and adaptable to the individual needs of students. Technologies allow access to an infinite amount of information, which can be used to enrich the content covered in the classroom. In addition, the Internet and digital tools make it possible to connect with people and places far away, expanding the possibilities of learning beyond the school walls.

One of these technologies concerns robotics. According to Martins (2006), robotics is the science that studies systems that interact with the real world without the need for human intervention. In the educational context, robotics aims to provide an environment where students can learn not only to build and manipulate robotic products, but also to understand the logical concepts involved in different processes. This stimulates creativity, logical reasoning, and protagonism in the educational process.

The introduction of educational robotics in schools, which is multidisciplinary in nature, promotes the development of fundamental aspects for young people, such as logical thinking, problem solving, hypothesis generation, elaboration of solution strategies, communication, and socialization, among others (ORRÚ, 2017). Robotics is considered an important tool for the inclusion of students with disabilities, especially those with Autistic Spectrum Disorder (ASD). ASD is described as human behaviors that focus on the person themselves and can cause delays and deviations in the development of social, communication, and other skills. Generally, people diagnosed with autism have difficulties in communication and social interaction, but some have specific interest in areas of exact and technology (BARTOSZECK; GROSSI, 2018).

In this paper, we intend to carry out a systematic literature review based on works that relate educational robotics and autism spectrum disorder. Its purpose is to identify the benefits of this approach in the cognitive, social, and emotional development of children with ASD.

The justification for this research is based on the need to find effective educational strategies to assist the development of skills in children with ASD. A systematic literature review is needed to gather and analyze existing studies on the subject, identify gaps in knowledge, and provide subsidies for the implementation of educational robotics programs for children with ASD. In addition, the research may contribute to the construction of more effective teaching guidelines and strategies that can be applied in inclusive educational settings.

This work is structured in four distinct parts. The first corresponds to this introduction, in which a brief general presentation of the theme is made. The second corresponds to the methodology, in which we intend to describe how this systematic review was carried out. The third one points to the results and presents their discussion. The last one concerns the final considerations of this study.

II. Material And Methods

The present article is a bibliographical survey. A bibliographical survey is one whose purpose is to collect, in a secondary manner, data from cultural or even scientific contributions that have already, at some point, been made. It is, then, a work of reading. This does not mean, however, that it is done in a superficial way. Quite the contrary: the bibliographical survey is characterized by careful reading of research already conducted by other authors on the subject in question (TOZONI-REIS, 2009).

It begins, precisely, by the responsible choice of such authors. This means that one cannot, in order to produce knowledge, select reference works (whether scientific articles or books) that have not been produced from the criteria of scientific rigor (TOZONI-REIS, 2009).

This, then, is a systematic literature review. Systematic reviews, Baek et al. (2018) state, follow specific guidelines, including defining the question to be addressed, selecting databases to search and collect material, creating advanced search strategies, and selecting and organizing the information found.

According to Kitchenham and Charters (2007), the Systematic Literature Review follows a well-established method, highlighting unbiased and repeatable contributions regarding a subject or phenomenon, through the analysis of specific research questions. Therefore, in this study, an RSL protocol will be developed based on the models proposed by Kitchenham and Charters (2007), covering the stages of planning, execution, and obtaining results.

As for the Boolean operators, their name comes from George Boole, an English mathematician. Their purpose is to define how the various results obtained will be combined. There are three Boolean operators, namely:

- AND, in whose result are all the searched terms.
- OR, in the result of which at least one of the search terms is found.
- NOT, when the searched terms do not exist. Thus, a very generic and often ineffective search is proposed (GALVÃO et al., 2014).

In the present systematic literature review, the Boolean operator AND was used to identify the simultaneous occurrence of the researched subjects. This work used the following descriptors, in two different languages:

TABLE 1 - SEARCH STRING

AUTISM AND ROBOTICS AND TEACHING

AUTISM AND ROBOTICS AND TEACHING

Source: Prepared by the author, 2023.

As soon as the search string was drawn up, an attempt was made to develop some questions that would serve as a basis to guide the research.

CHART 2 - RESEARCH QUESTIONS

QP1: In which countries have the papers been published?
QP2: What types of papers were selected: theses, articles, dissertations?
QP3: How do such works articulate TEA and Robotics in the School Context?

Source: Prepared by the author, 2023.

From these questions, plus the search string, the inclusion and exclusion criteria were drawn up.

CHART 3 - INCLUSION AND EXCLUSION CRITERIA

INCLUSION CRITERIA	EXCLUSION CRITERIA
CI1: Publications with a time frame of 2019 to 2023.	CE1: Abstracts, paid work, or work to which access is not authorized by the authors.
CI2: Documents that contain in their title, abstract, or keywords the searched terms that directly relate teaching, robotics, and ASD.	CE2: Papers that do not expressly contain in the search method the terms of the search equations.
CI3: Journal Articles, Journals, Thesis or Dissertations.	CE3: Publications in congresses, scientific events, conventions, conferences, symposia, seminars, monographs, and book chapters.
CI4: Peer-reviewed papers.	CE4: Documents in languages other than Portuguese or English.

Source: Prepared by the author, 2023.

DIGITAL LIBRARIES AND RETURNED WORKS

BDTD

The Brazilian Digital Library of Theses and Dissertations (BDTD) makes available, in a single search portal, the full texts of theses and dissertations produced in Brazilian educational and research institutions. Access to this scientific production is free of charge.

The BDTD aims to increase the presence of Brazilian theses and dissertations on the internet, which results in greater disclosure of national scientific production and the dissemination of relevant information to society in general. Furthermore, BDTD also promotes greater visibility and control of the investment made in graduate programs.

In the search conducted with the string a search was returned that matched the inclusion and exclusion criteria. In the search conducted with the English language string no searches were returned.

Google Scholar

Google Scholar is a free platform offered by Google that allows the search for various types of academic content, such as reports, articles, digital books, among others. These materials are fundamental to theoretically support research and studies.

In the search conducted with the string, 1480 results were returned at first. Of these, 977 matched the years between 2017 and 2023. When applying CI2 and CI3, this number fell to 29. Then, when the exclusion criteria were finally applied, this number fell to 4 searches.

In the search conducted with the English language string, 1980 results were returned. Of these, 654 matched the years between 2017 and 2023. When applying CI2 and CI3, this number fell to 32. Finally, when applying the exclusion criteria, this number fell to 3 searches.

Thus, the following papers were gathered in all:

TABLE 4 - RETURNED SEARCHES AFTER THE SELECTION CRITERIA

ID	TITLE	YEAR
T1	Learning and development of higher mental functions in children with Autistic Spectrum Disorder	2023
T2	Educational robotics and the learning of rules in the classroom: an inclusive proposal	2020
T3	Socially Assistive Robotics and its application in the treatment of autistic children	2022
T4	Robotics and Autistic Spectrum Disorder in publications with a school educational focus	2022
T5	The use of robotic technology as an integrative practice in the treatment of Autism Spectrum Disorder	2022

T6	Exploring the Potentials of Robotics in Supporting Children with Autism Spectrum Disorder	2021
T7	Coopertive strategies for children with autism spectrum disorders in inclusive robotics activities	2020
T8	The use of social robots with children and young people on the autism spectrum: A systematic review and meta-analysis	2022

Source: Prepared by the author, 2023.

III. Result

Having made these methodological considerations, the results of this research can then be presented.

First of all, it is worth mentioning the first research question, QP1: In which countries were the papers published?

Notably, T1, T2, T3, T4 and T5 were published in Brazil. T7 was published in the Philippines. T8 was published in Greece, while T6 appeared in the United States.

The second research question (QP2), on the other hand, corresponds to: "What are the types of papers selected: theses, articles, dissertations?" The following table intends to elucidate the question:

TABLE 5 - TYPE OF SELECTED PAPERS

KIND OF WORK	
Thesis	T1
Dissertation	T3, T6
Article	T2, T4, T5, T7, T8,

Source Prepared by the author, 2023.

Finally, regarding the last research question, QP3, which can be formulated this way: "In what way do these works articulate TEA and Robotics in the School Context?", the following answer was reached.

T1 concludes that it is of great importance to have a coordinated action between universities and schools so that the latter can take advantage of the robotics kits in the most effective way possible. Moreover, says the author (CUNHA, 2023), robotics activities can contribute to the inclusion of children with ASD, since the surveyed children found it easier to interact with their peers during these activities.

T2, by Monteiro et al. (2020), intends that robotics classes for autistic students be planned according to three principles: offer multiple forms of involvement, providing stimulus and motivation for learning; use different strategies and resources to represent information, taking into account that students understand in different ways; allow different forms of action and expression, considering the different ways of participation and expression of students.

In addition, they say, students with difficulty in concentrating and following the rules are expected to have understood the sequence of steps in their daily lives, to learn from their peers, to respect their particularities, to make the actions of reading, listening, and producing oral narratives of students with difficulty in expression more flexible with the help of concrete supports and peers, and to minimize barriers and have collective involvement to achieve the learning objectives.

T3, prepared by Valença (2022), a master's thesis, concludes that, more important than just using a computer program or virtual environments, interaction with a physical robot brings important real-time benefits, such as the social interaction of autistic children with humans.

For this reason, states Valença (2022), researchers have explored the idea of using robots to encourage the child to actively initiate social interactions. One of the reasons for using robots in the treatment of Autistic Spectrum Disorder (ASD) is that the child tends to interpret the robot as a toy, which generates empathy and engagement with the mobile platform.

T4 takes stock of some publications in the field of education that relate robotics and autism. According to the authors (PEDROSA; CALDEIRA; MATOS, 2019), the literature is still limited regarding robotics/technology and autism, especially in the school context. Only one of the studies they evaluated focused on pedagogical practices with students. Importantly, none of the studies found were conducted in Brazil, which indicates the need for investment in this area in the country, the authors state.

T5, the work of Freire et al. (2022), when conducting research with a group of students, realized that the use of robots in the clinical practice of individuals with Autism Spectrum Disorder (ASD) is efficient. This efficiency stands out in the amplification, capture, and understanding of gestures, especially in non-verbal individuals. In addition, robots help in stimulating emotional understanding and social cognition, in imitational reverberation as a tool to aid vocalization, and in limiting stereotyping.

The study by Quinn (2023), which corresponds to T6, states that robots, in schools, can be used as learning tools, encouraging skills such as problem solving, logical reasoning, motor coordination, and

concentration. Through practical and playful activities, autistic people have the opportunity to experiment, explore and learn in a more engaging and motivating way.

T7, in turn, developed by Filipino researchers, intends that much of the research they consulted stated that the skills of autistic learners most developed in robotics classes would be the social ones. These would have a great gain during work with the kits.

T8, work by two Greek researchers (TSIOMI; NANOU, 2022), claims that in robotics activities, from their readings of other research, all students work together in all aspects, such as design, assembly, programming, testing, debugging, and modification. Children working together need to use social skills, such as integrating other people's ideas, negotiating and coordinating viewpoints, and seeking agreement. Effective collaboration is accomplished through pre-defined but interchangeable roles. Therefore, these authors state, corroborating other works analyzed here, such as T7, that the main skills to be worked on in students with ASD would be the social ones.

IV. Conclusion

Finally, it was realized in this systematic review that, first, the literature in this regard is relatively incipient, since the reports of work with robotics and students with ASD are relatively scarce. What there are, in fact, are texts that address this issue, but outside the school environment, such as clinics, for example.

The school environment favors the contact of the person with ASD with typical students. Robotics, we could see, turned out to be a very effective strategy, if we are to believe the works analyzed here, to promote interaction between typical and autistic students.

It is worth mentioning that for future works, the time frame that covers the research can be extended, and new descriptors can be included with the purpose of finding a larger number of experience reports on the use of robotics in the classroom and its work, especially with autistic children.

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