EDUCAÇÃO EM FOCO
PROGRAMA DE PÓS-GRADUAÇÃO EM EDUCAÇÃO | UNIVERSIDADE DO ESTADO DE MINAS GERAIS

# O uso do Scratch no desenvolvimento de habilidades cognitivas e socioemocionais de estudantes autistas: uma revisão sistemática

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**Resumo**
O objetivo desta pesquisa é apresentar os resultados de uma Revisão Sistemática da Literatura para explorar o potencial de usabilidade do *software Scratch* no desenvolvimento de habilidades cognitivas e socioemocionais em indivíduos com Transtorno do Espectro Autista (TEA). O *Scratch* é uma linguagem de programação visual, baseada em blocos, que se encaixam como peças de Lego ou quebra-cabeças, tornando mais simples o processo de construção de algoritmos. Os sete estudos que compuseram a RSL foram extraídos após a aplicação de critérios de inclusão e exclusão em três bases digitais internacionais e uma nacional. A relevância desse estudo reside em compreender abordagens pedagógicas que utilizam o *Scratch* como mecanismo para incentivar habilidades cognitivas e socioemocionais em indivíduos com TEA. A análise dos trabalhos foi de natureza qualitativa e investigou a adequação do software a critérios de usabilidade voltados ao público-alvo. Os resultados apontam que o *Scratch* tem potencial para incentivar habilidades sociais, de memória, imaginação e criatividade em estudantes autistas.

**Palavras-chave**: Autismo. Programação. Usabilidade.

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# The use of Scratch in the development of cognitive and socio-emotional skills in autistic students: a systematic review

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**Abstract**
The objective of this research is to present the results of a Systematic Literature Review to explore the usability potential of Scratch software in the development of cognitive and socioemotional skills in individuals with autism spectrum disorder (ASD). Scratch is a visual programming block-based language which fit together like Lego pieces or puzzles, making the process of building algorithms simpler. The seven studies that made up the Review were extracted by applying inclusion and exclusion criteria in three international and one national digital database. The relevance of this study lies in understanding pedagogical approaches that use Scratch as a mechanism to foster cognitive and socioemotional skills in individuals with ASD. The study conducted a qualitative data analysis that investigated the suitability of the software to usability criteria aimed at the target audience. Results highlight Scratch as a potential tool to encourage social, memory, imagination and creativity skills in autistic students.

**Keywords**: Autism. Schedule. Usability.

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# El uso de Scratch en el desarrollo de habilidades cognitivas y socioemocionales en estudiantes autistas: una revisión sistemática

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**Resumen**
El objetivo de esta investigación es presentar los resultados de una Revisión Sistemática de la Literatura para explorar el potencial de usabilidad del software Scratch en el desarrollo de habilidades cognitivas y socioemocionales en individuos con Trastorno del Espectro Autista (TEA). Scratch es un lenguaje de programación visual, basado en bloques, que encajan como piezas de Lego o rompecabezas, simplificando el proceso de construcción de algoritmos. Los siete estudios que conformaron la RSL fueron extraídos luego de aplicar criterios de inclusión y exclusión en tres bases de datos digitales internacionales y una nacional. La relevancia de este estudio radica en comprender los enfoques pedagógicos que utilizan Scratch como mecanismo para fomentar habilidades cognitivas y socioemocionales en personas con TEA. El análisis del trabajo fue de naturaleza cualitativa e investigó la adecuación del software a los criterios de usabilidad dirigidos al público objetivo. Los resultados indican que Scratch tiene el potencial de fomentar habilidades sociales, de memoria, imaginación y creatividad en estudiantes autistas.

**Palabras clave:** Autismo. Cronograma. Usabilidad.

## Introduction

Autism Spectrum Disorder (ASD) has garnered significant attention from researchers worldwide due to the exponential increase in reported cases in the literature (ZEIDAN et al., 2022). This spectrum is characterized by difficulties in maintaining appropriate relationships concerning developmental levels, repetitive/restrictive patterns of behavior, stereotypies, and impairments in social interactions and communication (DSM-5).

According to Zauderer (2022), approximately 1% of the global population receives a diagnosis of autism, and since the year 2000, there has been a 178% increase in the prevalence of autism. In the case of Brazil, precise data on the prevalence of diagnoses are not available; however, based on the 2022 School Census conducted by the National Institute for Educational Studies and Research Anísio Teixeira (INEP), there were 294,394 autistic students enrolled in special education in 2021.

In this context, discussions about the inclusion process, equal opportunities, and respect for individual needs become relevant. Individuals within these spectrum exhibit impairments related to social skills, communication, behavior, differing patterns of interests, and resistance to change (SILVA; GAIATO; REVELES, 2012).

Due to these limitations, autistic students often face challenges in socialization, organization, and attention in the school environment, which requires educational institutions to improve their qualifications to accommodate these students, particularly teachers (FERREIRA; FRANÇA, 2017). Educational inclusion demands that teachers adopt a differentiated approach to teaching methodology that can assist these students in the learning process. Digital technologies are constantly and indispensably present in our rapidly changing society and can serve as an important pedagogical tool in teaching and learning processes (SANTOS, 2016).

In this perspective, the present Systematic Literature Review (SLR) aims to explore the usability[4] potential of the Scratch software[5]for the development of cognitive skills (mental processes involved in knowledge acquisition) and socio-emotional skills (the ability to manage social relationships and interactions) in individuals with Autism Spectrum Disorder (ASD). The review

[4] It is defined by ISO 9241-11 (ABNT, 2002, p. 3) as "the measure to which a product can be used by specific users to achieve specific goals with effectiveness, efficiency, and satisfaction in a specific context of use".

[5] Scratch is software created by the Lifelong Kindergarten research group at MIT Media Lab in 2004. It features an intuitive interface that allows users to create or modify projects without prior programming experience. Users can drag and connect "blocks," which have different types of actions and are identified by colors, enabling the creation of combinations that can be used in project development (PINTO; ESCUDEIRO, 2014).

seeks to provide an overview of the research conducted both nationally and internationally on the main studies that report this relationship between autistic individuals and the use of Scratch.

Based on the relevance of this theme, the present article seeks answers to the following questions: Do studies indicate usability criteria for Scratch for individuals with Autism Spectrum Disorder (ASD), taking into account their specific characteristics and needs? What cognitive and socio-emotional skills have been identified in individuals with Autism Spectrum Disorder (ASD) through pedagogical approaches that utilize Scratch?

The study is justified by the substantial increase in autism diagnoses globally, and the inherent challenges associated with the disorder create opportunities for research discussing the use of technologies as a means to improve the quality of life, learning, and development of individuals within the spectrum (ALVARENGA-DIAS; SOUZA, 2020).

There is a variety of studies dedicated to exploring technologies aimed at autism, such as those by Hani and Abu-Wandi (2015), who presented the Dissero app, which aims to promote learning and entertainment for its users, demonstrating improvements in the mental and social skills of students with ASD. Naranjo (2017) studied a 3D virtual application that immersed students in virtual reality (simulating the user's presence in the game) through avatars (graphic representations used to represent users in virtual environments) controlled by robots, resulting in advancements in socialization and communication processes. Wright et al. (2021) used the Ozo Blockly software, which employs a robot programmed in a basic programming language based on block-fitting to teach programming logic and coding to students.

The Kids Play application for computers, created to assist children with learning difficulties in early childhood education, utilized a touch-sensitive interface[6] that stimulated language development and geometric shape recognition (NUR; JAHAN; MOSTAFA, 2020). As methodological tools to support reading development and text comprehension, the GoTalk OW app (ALISON et al., 2017) and HP Reveal (HOWORTH et al., 2019) have demonstrated significant advances in this area of knowledge, as they use interactive and visual means to engage users, facilitating information assimilation and story creation.

The Pixton software employed a digital comic strip approach as a way for students to express their opinions on social contexts, demonstrating progress in social interaction and communication (MOHAMAD, 2020). The use of avatars was also observed in the TeachLivE software, which

[6] When the user engages in physical (such as touch or sight) or conceptual contact during interaction with a virtual system (BARBOSA; SILVA, 2010)

simulated a virtual classroom and encouraged teachers to develop methodologies that stimulated the resolution of mathematical problems, as autistic individuals often face challenges in this area of knowledge (DELISIO; DIEKER, 2019).

Despite the numerous studies in the field of digital technology, there is a notable scarcity of research dedicated exclusively to the usability and accessibility of these resources for individuals on the spectrum. As technology becomes essential for society, it is vital to ensure that the necessary interfaces are accessible to all populations, including autistic individuals (ALZAHRANI; UITDENBOGERD; SPICHKOVA, 2021).

This article is organized into four sections. Following this introduction, the methodology of the study will be presented, along with the studies related to the proposed theme. Next, a discussion of the results will be conducted in light of the theories. Finally, the conclusions of the study and suggestions for future research will follow.

## Methodological Procedures

This article is the result of a bibliographic research that utilizes the Systematic Literature Review method, following the principles proposed by Kitchenham (2004). The systematic review is a type of secondary study that, according to Prodanov and Freitas (2013), obtains data through bibliographic research, with sources including newspapers, statistical records, journals, books, letters, etc. Through this method, it is possible to identify, analyze, and interpret various variables related to the object of study.

The steps followed in this review, according to Kitchenham (2004), were:

I. Planning: This stage involves defining the main information for the review, such as the research questions, the sequence of words used, known as the string, and the databases from which the articles are extracted.
II. Execution: In this stage, the strings are applied to the databases, followed by the selection of articles based on inclusion and exclusion criteria, and subsequently, the data are extracted and summarized.
III. Reporting: This stage involves presenting the results found in the academic works.

## Research Questions

With the aim of exploring the usability of Scratch for the development of cognitive and socio-emotional skills in individuals with Autism Spectrum Disorder (ASD) and to outline an overview of the research conducted both nationally and internationally, the following guiding questions were formulated: Do the studies indicate usability criteria for Scratch for individuals with Autism Spectrum Disorder (ASD), taking into account their specific characteristics and needs? What cognitive and socio-emotional skills have been identified in individuals with Autism Spectrum Disorder (ASD) through pedagogical approaches that utilize Scratch?

## Search Procedures

To conduct the search for articles, the creation of keywords based on the central theme of the study was initially planned: Evaluation of the usability of Scratch software as a tool for cognitive and socio-emotional development in individuals with Autism Spectrum Disorder (ASD). For the definition of the search string (Table 01), several combinations of keywords were made to broaden the results obtained. The selected terms took into account the research questions, so they were grouped under the following scope: Software, educational context, and individuals within the Autism Spectrum Disorder.

**Table 01** – Search String Used in the Databases

| Scope | String in Portuguese | String in English |
|---|---|---|
| Software | Scratch AND | Scratch AND |
| Educational Context | AND educação | AND education |
| Individuals within the Autism Spectrum Disorder | AND autismo | AND autism |

Source: Prepared by the authors (2023)

To search for articles in Portuguese, national digital databases were accessed where the string in Portuguese was applied. Similarly, the search for articles in English took place in international digital databases, using the corresponding string in English (Table 02). The boolean operator AND was used to connect the terms: Scratch, education, and autism. The period defined for the search for articles was from 2012 to 2022, excluding 2023, the year in which this systematic review took place.

**Table 02** – Research Databases and Electronic Address

| Database | Electronic Address | Type of Database |
|---|---|---|
| Google Scholar | https://scholar.google.com/ | National |
| IEEExplore. | https://ieeexplore.ieee.org/Xplore/home.jsp | International |
| ACM Digital Library | https://dl.acm.org/ | International |
| PubMed | https://pubmed.ncbi.nlm.nih.gov/ | International |

Source: Prepared by the authors (2023)

By combining Google Scholar with specialized databases such as IEEE Xplore, PubMed, and the ACM Digital Library, it was possible to broaden the literature review, incorporating both the perspectives of national researchers and those of international experts on the subject, active in specific areas such as technology engineering, education, and multidisciplinary fields.

According to Kitchenham (2004), after selecting the primary data obtained through the application of the string, a more in-depth search for articles considered relevant to the research object needs to be conducted, as many results obtained from the initial search often do not relate to the topic under study. Thus, Inclusion Criteria (IC) and Exclusion Criteria (EC) were established, as shown in Table 03 below:

**Table 03** – Inclusion and Exclusion Criteria.

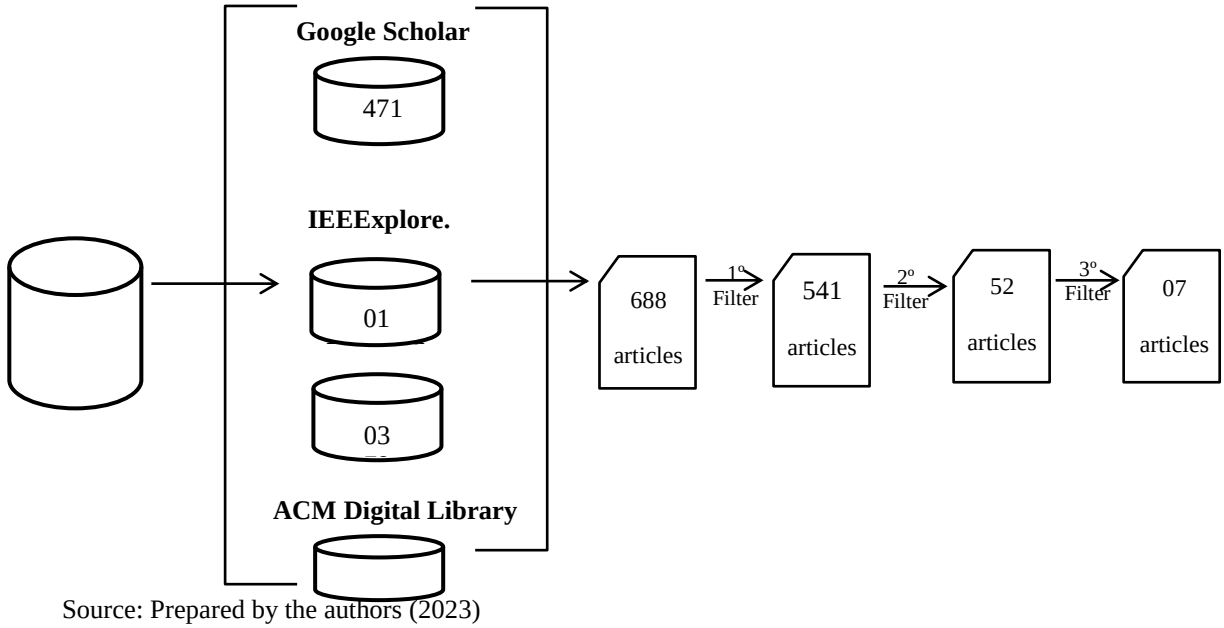
| **Inclusion Criteria** | **Exclusion Criteria** |
|---|---|
| (CI.1) Works published in Portuguese and English between the years 2012 and 2022; | (CE.1) Duplicate works, Systematic Literature Reviews, and conference articles; |
| (CI.2) Full articles published in national and international scientific journals or magazines; | (CE.2) Works focused exclusively on the health sector; |
| (CI.3) Works that necessarily address the use of Scratch software in the context of individuals with ASD in the title or abstract. | (CE.3) Works that exclusively reference the families of autistic individuals. |

Source: Prepared by the authors (2023)

## Results and Conduct of the Research

Upon applying the strings in the cited databases, a total of 688 works were returned, as represented in Figure 01. Subsequently, a sequence of three filtering processes was carried out, considering the exclusion and inclusion criteria described in Table 03. In the end, seven works were obtained, consisting of six journal articles and one master's thesis, all of which were read in full to address the research questions.

**Figure 01:** Flowchart of Article Selection




Source: Prepared by the authors (2023)

**Figure 01** shows the process of selecting articles for the systematic review: first, after applying the search string in the selected databases, 688 articles were obtained. Next, the application of temporal filtering criteria (2012 to 2022) and articles written in English or Portuguese reduced the result to 541 studies. Subsequently, filters were applied to the titles and abstracts of these works, reducing the number to 52 studies. Following this, the inclusion and exclusion criteria were applied, resulting in a final total of 07 works that will be read in full to answer the proposed questions. After examining the available databases, a significant gap in the literature regarding the study of autism in conjunction with the use of Scratch software was identified.

## Selected Works

After searching for and selecting relevant works, with the aim of organizing and presenting the results from the consulted sources, the 07 publications selected for this review were organized in the form of a synthesis matrix, as shown in Table 04.

**Table 04 -** Selected Works

| ID | TITLE OF RESEARCH PUBLICATION | AUTHOR/YEAR | PUBLICATION | DATABASE |
|---|---|---|---|---|
| T01 | A Scheme for Story Authorship in Virtual Worlds | Viana-Junior, (2015) | Proceedings of the XXVI Brazilian Symposium on Computer Science in Education | Google Scholar |
| T02 | Digital Inclusion through Maker Culture in Public Schools: A Collaborative Scratch Experience with Autistic Students | Brito; Gama e Brasileiro (2018) | Journal of Science and Humanities Education-Cidadania, Citizenship, Diversity, and Well-Being - RECH | Google Scholar |
| T03 | Development of a Playful Device to Assist Children with Cognitive Development Disorder. | Dantas (2018) | Master's Thesis in Cognition, Technology, and Institutions | Google Scholar |
| T04 | Using Scratch to Teach Thermochemistry to Students with ASD | Montemor, et al (2022) | Macambira Notebooks | Google Scholar |
| T05 | Technology as a Premise for Pedagogical Innovation and Inclusion of People with Disabilities | De Oliveira e Pletsch (2022) | Interinstitutional Journal of Arts in Education - RIAE | Google Scholar |
| T06 | Virtual Floortime Using Games to Engage Children with Autism Spectrum Disorder | Sarachan (2012) | IEEE International Games Innovation Conference | IEEExplore |
| T07 | Digital Fabrication and Theater: Developing Social Skills in Young Adults With Autism Spectrum Disorder | Poveda e Montoya (2021) | Journal Frontiers in Psychology | PubMed |

Source: Prepared by the authors (2023)

## Discussion and Results

In this section, the responses and discussions related to each research question will be presented, examining qualitative aspects and organizing the data extraction from the selected works according to their respective inquiries. The aim is to provide a thorough and detailed analysis of the consulted studies from the perspective of usability analysis of Scratch software for individuals within the Autism Spectrum Disorder (ASD).

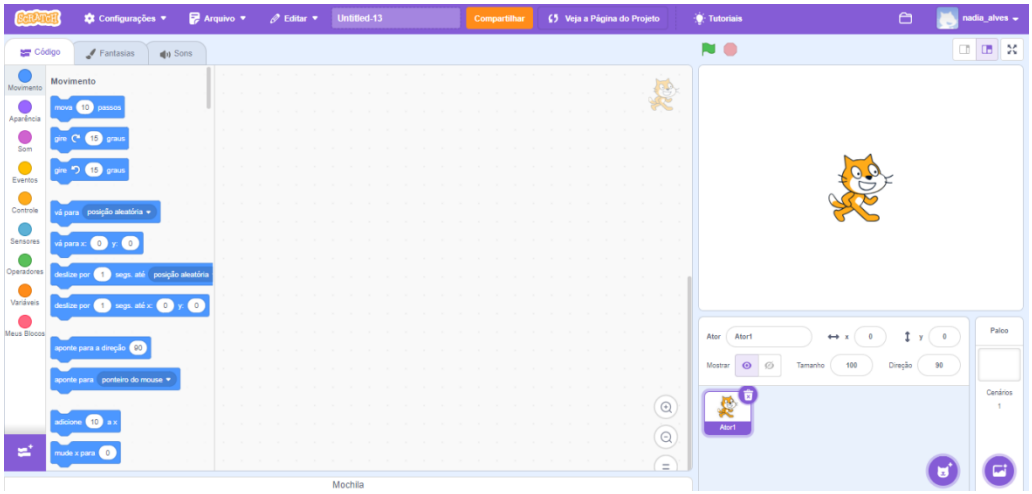
### QP1 - Do the studies indicate usability criteria for Scratch for individuals with Autism Spectrum Disorder (ASD), taking into account their specific characteristics and needs?

Currently, society is immersed in Digital Information and Communication Technologies [7]TDIC, which impact all spheres of modern society, shaping the way people live, work, and interact. Educational environments are no exception to this reality, and according to Sáez-López et al. (2016), they are seeking technological tools that can establish challenges focused on active, creative, and collaborative learning.

Scratch is part of a new generation of technologies designed to help prepare students to meet the current demands of society, such as creative thinking skills, systematic planning, critical analysis, collaboration, clear communication, interactivity, and continuous learning (PINTO; ESCUDEIRO, 2014).

Scratch was created by the Lifelong Kindergarten research group at MIT Media Lab in 2004. It features an intuitive interface that allows for the creation or modification of projects, even for those without programming experience. Users can drag and connect "blocks" that have different types of actions and are color-coded, enabling the creation of combinations that can be used in project development (PINTO; ESCUDEIRO, 2014). The following figure demonstrates the programming environment of Scratch*:*

**Figure 02:** Scratch Programming Environment




Source: Prepared by the authors (2023)

[7] Digital technological tools that we use for the creation, publication, and consumption of information, as well as the various physical components and their solutions that we use to communicate (SILVA, 2020).

Usability is defined by ISO 9241-11 (ABNT, 2002, p. 3) as "the measure to which a product can be used by specific users to achieve specific goals with effectiveness, efficiency, and satisfaction in a specific context of use." Therefore, usability is associated with the ease with which the user interacts with the digital informational environment (ROCHA; DAVID, 2020). Analyzing usability in the context of Scratch is important, as it directly influences the user experience, their ability to learn and create, as well as their ongoing engagement.

From the perspective of this study, usability relates to the ability of individuals with Autism Spectrum Disorder (ASD) to intuitively, efficiently, and inclusively use Scratch. This software utilizes logical blocks and sound and image items for the development of interactive stories, games, and animations (BRITO; GAMA; BRASILEIRO, 2018).

High-functioning individuals with ASD (who do not require much support from others) often face challenges in social interaction, which can lead to lower engagement with peers, a greater tendency toward parallel play, less reciprocal behavior, and difficulty maintaining eye contact (SARACHAN, 2012). However, it is essential to highlight their skills and talents, such as advanced visual memory, attention to detail, accuracy, memorization ability, and a propensity to maintain routines or processes in a standardized manner. Furthermore, attachment to routine can be beneficial in the workplace, promoting loyalty and honesty (ONG, AUTISMO E REALIDADE, 2016).

Considering these characteristics of autism, Pagani (2020) created the GAIA Project - Web Interface Accessibility Guide focusing on Aspects of Autism, or Guidelines for Accessible Interfaces for People with Autism. This project consists of a set of recommendations to make websites and software more accessible, aiming to assist developers in better understanding the specific needs of the autistic audience. This is relevant, considering that an inadequate user experience can increase the effort required for use, causing stress, irritation, and anxiety, thus compromising pedagogical and therapeutic objectives.

According to the GAIA Project (2020), the guidelines are divided into 10 categories:

- Visual and Textual Vocabulary: Colors should not be the only way to convey content; appropriate contrast should be ensured, and information must be understandable without images or visual styles. The visual and textual language should be simple, clear, and concise. Icons, images, action names, and menus should be realistic and represent real-world actions and activities to facilitate recognition and understanding.
- Customization: Allow users to make adaptations to the interface to suit their particularities.

- Engagement: Use a minimalist approach, eliminating distractions and organizing the visual layout of the interface to reduce cognitive effort, grouping similar elements together and separating unrelated content, while providing clear instructions.
- Redundant Representations: Information should not be presented in only one form (text, image, or sound).
- Multimedia: Reinforce recommendations that complement redundant representations by providing information in multiple formats (text, video, audio, and images).
- Responses to Actions: Provide clear feedback for correct actions or errors, using audio, text, and images, avoiding icons with emotions or facial expressions.
- Visibility of System Status: The system should offer information about status, progress, and errors.
- Recognition and Predictability: Provide instructions and immediate feedback regarding interaction restrictions with the system or specific elements; similar elements and interactions should produce similar, consistent, and predictable results, and icons, buttons, and form controls should be large enough to provide a sufficient click area.
- Navigability: It should be simple and avoid redirections.
- Touch Screen Interaction: The touch screen should have appropriate sensitivity to prevent selection errors and accidental touches on screen elements.

In the studies conducted by Montemor et al. (2022), some of the guidelines from the GAIA Project can be observed in the adaptation of chemistry teaching materials for students with ASD, utilizing Scratch to learn the specific concepts of thermochemistry. One of the strategies used was the inclusion of individual explanatory audio recordings that addressed each step of applying Hess's Law, accompanied by specific illustrations to adapt theoretical concepts related to this law. "Next" and "Previous" buttons were added to the screen, allowing the student to advance or go back in the content as needed.

A drag-and-drop system with predetermined options was implemented, making the process more intuitive. Additionally, complex calculations were adapted to allow a click on a specific button and automated enthalpy programming, enabling the student to focus on the theory, which is the subject of the lesson.

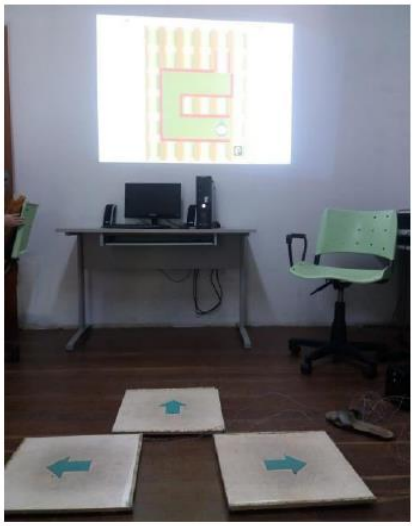
The works of Sarachan (2012), Tavares (2015), Brito, Gama, and Brasileiro (2018), Poveda and Montoya (2021), and Oliveira and Pletsch (2022) highlight that Scratch uses blocks for creations,

interactive stories, animations, music, and art, through graphical blocks that fit together like Lego pieces or puzzles. These blocks are visually distinct and easy to understand due to their colors, with an interface designed to be clear and simplified through predictable visual elements. Oliveira and Pletsch (2022) compare them to constructing a puzzle, where the blocks are fitted together to create functionalities within the project.

According to the authors, the customization or personalization of projects was evident, as autistic individuals were able to create scenarios, characters, animations, and sounds, as well as choose the best font and size according to their individual preferences. Oliveira and Pletsch (2022) report on the experience of an autistic student who was bothered by excessive background noise during the construction of their project, revealing a usability issue related to noise pollution. However, with the ability to adjust the volume, the student was able to continue working on their project.

Dantas (2018) designed a device using Scratch programming and two wooden platforms connected to an Arduino board [8]. The purpose of the board developed with Arduino was to guide the avatar named Mega to the red space. The following figure illustrates the device more clearly:

**Figure 03** Developed Playful Device.



Source: Dantas (2018)

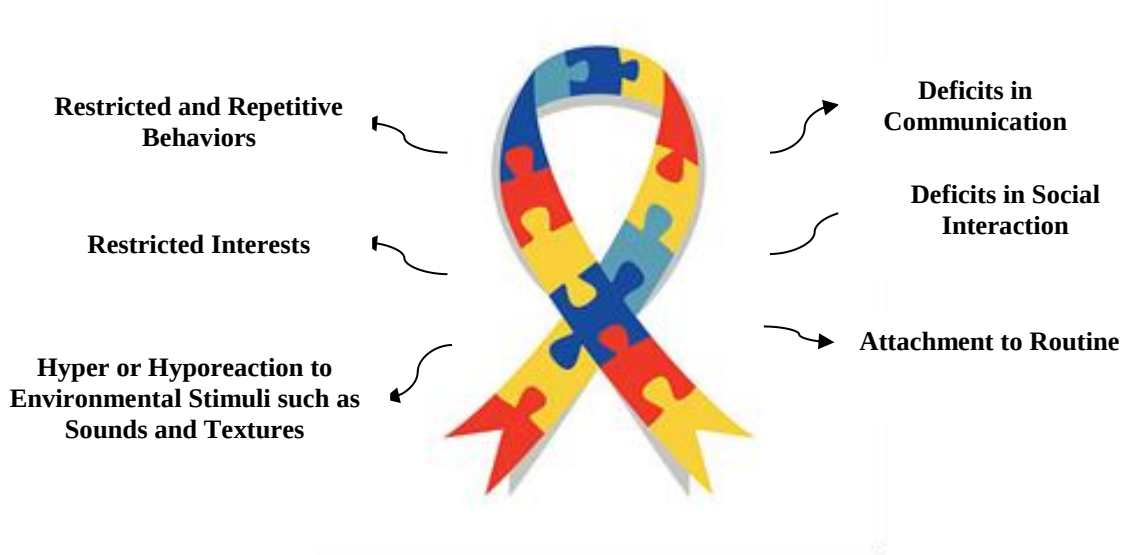
[8] Allows the creation of interactive projects through a programmable board and an accessible development environment (MCROBERTS, 2018).

The game was presented to students in a clear and simple manner, as well as being immersive, since it is controlled by touching wooden platforms. This type of physical control can be more intuitive and accessible for autistic individuals (DANTAS, 2018).

Although the studies successfully demonstrate experiences related to the usability of Scratch, it is important to avoid generalizations, as individuals with ASD exhibit significant variations in difficulties, skills, and needs (POVEDA; MONTOYA, 2021). Adopting an individualized and flexible approach is essential to create an inclusive and personalized experience, promoting efficiency, effectiveness, and satisfaction in interactions with digital environments.

According to the American Psychiatric Association (2014, p. 53), "Manifestations of the disorder also vary widely depending on the severity of the autistic condition, the level of development, and chronological age; hence the use of the term spectrum." Therefore, the diagnosis of ASD requires clinical experience, skill, and familiarity with child development. The diagnosis is based on the clinical history, including core symptoms of ASD and symptoms such as aggression, hyperactivity, among others. It also considers the developmental history, gestational background, child health, and family history. Teachers and caregivers are valuable sources of information, and home videos can assist in the evaluation. Direct observation or interviews with the child are essential (MONTENEGRO; CELERI; CASELLA, 2018).

**Figure 04:** Basic Characteristics of Autism




Source: Prepared by the authors (2023)

According to Brunetto and Vargas (2023), the symbol of autism, created in 1999, is a colorful ribbon featuring puzzle pieces. Its purpose is to raise awareness about ASD, representing the diversity of families with autistic members and the hope for interventions and social inclusion.

The diversity displayed by the autism symbol reinforces the thinking of Bernier et al. (2021), reflecting that although "autism" is a single word and a single diagnostic classification, it does not represent a single condition. There is a saying in the autism community that goes, "If you've met one child with autism, you've met one child with autism." Despite the diagnostic criteria being sufficiently clear, a wide range of different challenges and abilities fits within these criteria.

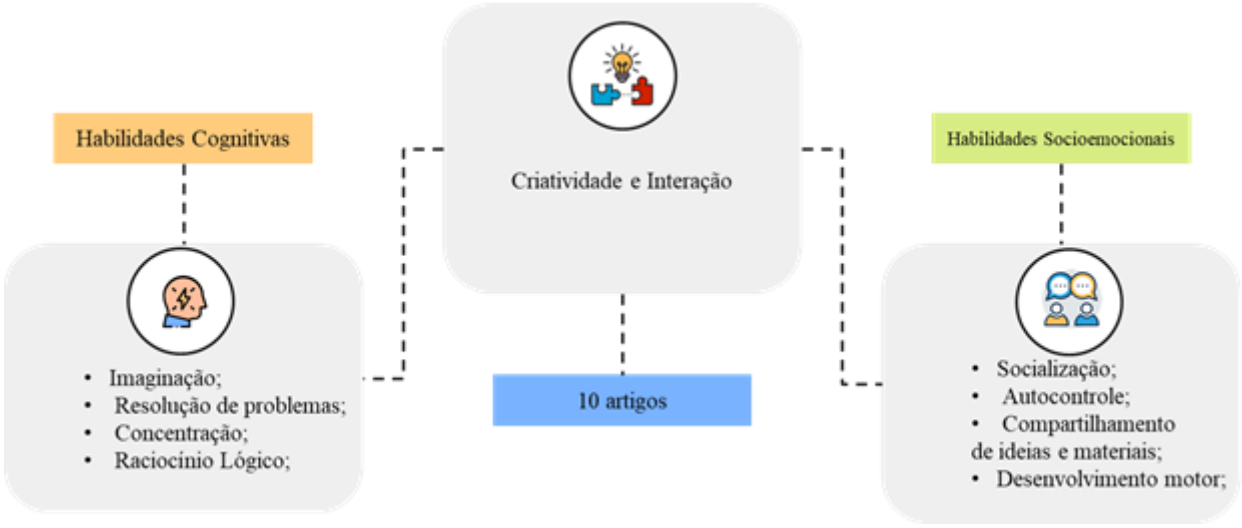
## QP2 - What cognitive and socio-emotional skills have been identified in individuals with Autism Spectrum Disorder (ASD) through pedagogical approaches that use Scratch?

Based on the final analysis of the selected works, the recurrence of creating digital stories using Scratch is highlighted, as evidenced in the studies by Viana-Junior (2015), Poveda and Montoya (2021), and Oliveira and Pletsch (2022). This approach encourages the development of social skills, memory, imagination, and creativity.

When determining the type of game to be created by the participants, social games that emphasize social interactions among participants, whether online or in physical formats, can provide an appropriate structure, as social skills are compromised in a large proportion of individuals within the spectrum (SARACHAN, 2012). According to Juul (2010), social games are those that encourage users to transform a social story into a form of digital narrative, encompassing five components: "fiction," "usability," "interruptions," "increasing difficulty," "mild punishments," and "rewards."

The following diagram illustrates the cognitive and socio-emotional skills mentioned in the works through the use of Scratch:

**Diagram 01:** Cognitive and Socio-Emotional Skills with Scratch




Source: Prepared by the authors (2023)

Cognitive and socio-emotional skills overlap because creativity and interaction are present in both cognitive and socio-emotional competencies. These overlaps highlight that the cognitive skills linked to socio-emotional skills are two sides of the same reality: the relationships established with others, with knowledge, with the environment, and individually, as cognitive and socio-emotional skills are not independent of one another (LOBO; SILVA, 2021).

In this regard, Resnick et al. (2009) emphasize that Scratch was designed to be interactive, allowing users to execute their codes by fitting blocks together. Furthermore, the primary goal of Scratch is not to train professional programmers but to encourage creative and systematic thinking, using programming as a form of expression. The following Table 01 presents a summary of the skills mobilized in students with autism through pedagogical approaches using Scratch:

**Box 01:** Skills Mobilized with the Use of Scratch

| STUDY | PEDAGOGICAL APPROACH | SKILL |
|---|---|---|
| De Oliveira e Pletsch (2022) | Creation of Virtual Stories | • Imagination;<br>• Creativity; |
| Brito; Gama e Brasileiro (2018) | Maker Approach | •Socialization; |
| Sarachan (2012) | Game Prototyping | • Creativity;<br>•Problem-Solving Skills; |
| Poveda e Montoya (2021) | Theater Aligned with Basic Digital Fabrication Technology Workshops | •Self-Control;<br>• Concentration;<br>•Sharing Ideas and Materials; |

| | | |
|---|---|---|
| Dantas (2018) | Playful Device | •Logical Reasoning;<br>• Motor Development;<br>• Interaction; |
| Montemor et al (2022) | Transformation of Chemistry Content into a Game.<br>Virtual Theater. | •Logical Reasoning; |
| Viana-Junior, (2015) | Virtual Theater. | •Interaction;<br>•Socialization;<br>• Creativity |

Source: Prepared by the authors (2023)

In the selected studies, interventions aimed at developing cognitive and socio-emotional skills tailored to the individual needs of autistic individuals were identified. According to Marteleto, Chiari, and Perissinoto (2020), these individuals may exhibit cognitive delays and deficits in logical and intuitive reasoning related to expressive language, which impairs their social skills. In the investigation by Oliveira and Pletsch (2022), students with ASD used imagination and creativity to add new elements, expressing their ideas in the development of a predefined story proposed by the researchers.

Sarachan (2012) proposed the creation of a game in which autistic children would be encouraged to transform everyday activities, such as going to the supermarket and buying food, into a personalized narrative. This aims to stimulate creativity and develop problem-solving skills through an introduction to robotics using Scratch.

Dantas (2018) and Montemor et al. (2022) share the approach of encouraging logical reasoning, although with distinct focuses. Dantas (2018) proposed the use of a playful device created with Scratch and complementary materials to stimulate not only this skill but also motor development and interactivity. On the other hand, Montemor et al. (2022) proposed transforming chemistry content into an interactive game, also utilizing the block programming proposed by Scratch.

According to Bernier, Dawson, and Nigg (2021), children with autism face social difficulties due to two main factors. The first is a lack of social motivation, meaning less interest and attention towards the social world and less value attributed to social information. The second factor is the difficulty in processing and understanding social information, such as accurately reading social cues, including facial expressions.

In the context discussed, Brito, Gama, and Brasileiro (2018) employed a maker approach[9], to promote collaborative learning. Students had the opportunity to create their own games using Scratch

[9] Addresses technology as a means to enable students to take ownership of techniques that allow them to become producers of technology rather than just consumers (RAABE; GOMES,2018).

based on concepts taught in the classroom, and they carried out this creation collaboratively with their peers. This methodology proved to be motivating in promoting the socialization of autistic children.

Similarly, Viana-Junior (2015) developed an approach focused on interaction, socialization, and creativity through virtual theater. Using Scratch as a development tool, students created and performed stories, providing opportunities for meaningful social interactions, even if virtually.

Poveda and Montoya (2021) proposed an approach that integrates theater and programming within the Scratch environment, aimed at including adult autistic individuals. This included basic workshops on digital content production technology. This approach resulted in significant benefits, such as the development of self-control when dealing with the frustration of making mistakes, increased concentration, and encouragement of the sharing of ideas and materials among participants.

## Final considerations

This Systematic Literature Review began with the guiding questions: Do the studies indicate usability criteria for Scratch for individuals with Autism Spectrum Disorder (ASD), taking into account their specific characteristics and needs? What cognitive and socio-emotional skills have been identified in individuals with ASD through pedagogical approaches that use Scratch? In response to these inquiries, a set of 07 scientific works was analyzed, reflecting the landscape of international and national research over a decade (2012 to 2022).

Based on the selected studies, it can be affirmed that the objective of exploring the usability potential of Scratch for developing cognitive and socio-emotional skills in individuals with ASD, using Kitchenham's (2004) methodological proposal, was successfully achieved. The survey conducted demonstrated, in light of scientific studies, that Scratch has usability potential for individuals with ASD, as well as significantly promoting the development of cognitive and socio-emotional skills in autistic individuals.

The works indicated that the creation of digital stories using Scratch was the most recurring activity. These approaches demonstrated the development of social skills, memory, imagination, and creativity in individuals with ASD, as Scratch was designed to stimulate creative and systematic thinking, using block programming as a form of expression (RESNICK et al., 2009).

Games were also identified as a framework for working on interactivity, creativity, and logical reasoning, as usability is related to the individual's ability with ASD to use Scratch intuitively and

efficiently. Scratch employs logical blocks and elements of sound and image to develop interactive stories, games, and animations (BRITO; GAMA; BRASILEIRO, 2018).

However, it is important to highlight the limitation of this research due to the restricted number of studies included in the systematic review. Although seven works were analyzed, the relatively low number may limit the generalization of results and the overall representativeness of the panorama. The scarcity of studies may be due to the limitation of research specifically addressing the usability of Scratch for the development of cognitive and socio-emotional skills in individuals with ASD.

Given Scratch's versatile nature, future work is suggested to explore other skills in autistic individuals, such as collaboration and critical thinking. It is also important to investigate the suitability of Scratch's resources by age group, for an appropriate pedagogical approach, in addition to creating adaptations to meet the specific needs of this audience.

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