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Inclusive Educational Design for Individuals with ASD

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Abstract. This work aims to understand individuals with Autism Spectrum Disorder (ASD) in the professional environment, specifically in the field of design, and their challenges when receiving feedback from neurotypical individuals regarding their work. The objective is to mitigate this issue through a proposed adaptation of the "Sticky Note" tool in Photoshop, which will facilitate communication between neurodivergent and neurotypical individuals in a professional context.

Keywords: *ASD, Design, Neurodivergent, Inclusion.*

INTRODUCTION

This paper presents a study on improving processes in the development of digital educational content through a computational tool designed to assist individuals with Autism Spectrum Disorder (ASD) in delivering presentations and receiving precise and comprehensible feedback. The aim of this study is to explore how individuals with ASD can receive feedback on their communication in a more direct and understandable manner during the educational process, which can help them develop their cognitive skills and competencies. This work is aligned with the provisions of Law No. 12.764/2012, specifically Article 2, Paragraph V, which promotes the integration of individuals with ASD into the workforce, taking into account the specificities of the disability within the context of Brazilian public law.

The inclusion of individuals with autism in the workforce is of growing importance. Despite existing Brazilian legislation that mandates measures to ensure inclusion of individuals with ASD [4], the reality remains challenging, particularly concerning professional opportunities in fields requiring specific skills, such as design.

According to the Brazilian Ministry of Health [5], Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by atypical development, behavioral manifestations, deficits in communication and social interaction, repetitive and stereotyped patterns of behavior, and restricted interests and activities. This work is motivated by the goal of improving communication and social interaction for professionals with ASD.

It is essential to recognize that adaptations are necessary to enable individuals with ASD to utilize their skills and competencies in the educational process and thereby enhance their chances of success in the job market. Unfortunately, as indicated by [3], there are still numerous barriers to be overcome, particularly for those living outside major urban centers or facing financial difficulties.

To better understand the realities faced by individuals with ASD in their learning journey and professional roles, it is crucial to create solutions that make the workplace more accessible and inclusive. These individuals possess the potential to develop specific skills and perform tasks requiring high concentration, as demanded in many professional careers.

This study underscores the relevance and importance of its topic, as individuals with ASD often excel in tasks requiring high concentration, such as activities emphasizing visual and logical-mathematical skills. Moreover, they frequently think "outside the box" when confronted with challenging situations, potentially fostering a more creative and dynamic classroom environment and, in the workplace, serving as a source of innovation for companies.

The central issue addressed by this study revolves around the challenges individuals with ASD face in interacting and communicating with neurotypical individuals in educational and professional environments, particularly how suggestions and criticisms may be interpreted denotatively and not fully understood by neurodivergent individuals. In this context, the guiding question of this study is: How can communication between neurotypical and neurodivergent individuals with Autism Spectrum Disorder be enhanced in educational and professional contexts?

As a resolution to the aforementioned problem, this study proposes the adaptation of a computational tool designed to facilitate communication in student or professional relationships between neurodivergent individuals with ASD and neurotypical individuals. This tool aims to meet the specific needs of individuals with

ASD, focusing on communication in making changes to educational and professional projects and content.

THEORETICAL BACKGROUND

In this item, a literature review on autism, inclusive design, communication, and accessibility is presented, emphasizing the need to enhance communication in professional environments for individuals with Autism Spectrum Disorder (ASD) and its contribution to accessibility and professional development.

AUTISM

The term Autism was first coined in 1911 by Eugen Bleuler to describe a condition where individuals live within themselves, as a form of detachment from reality. Derived from the Greek word "autos," meaning "self," this term is widely used today [2].

According to [1], "Autism Spectrum Disorder is characterized by persistent deficits in social communication and social interaction across multiple contexts, including deficits in social reciprocity, nonverbal communicative behaviors used for social interaction, and in developing, maintaining, and understanding relationships." Thus, Autism Spectrum Disorder is defined as follows: "Autism Spectrum Disorder is a new disorder in DSM-5 that encompasses autistic disorder (autism), Asperger's disorder, childhood disintegrative disorder, Rett syndrome, and pervasive developmental disorder not otherwise specified in DSM-IV. It is characterized by deficits in two core domains: 1) deficits in social communication and social interaction, and 2) restricted, repetitive patterns of behavior, interests, or activities". Nonetheless, it is important to note that the reference [1] is not free of criticism, as shown by [8].

Autism, as described by [9], is a complex disorder encompassing various conditions such as Pervasive Developmental Disorder, Asperger's Syndrome, and classic autism. Leo Kanner, a pioneer in autism research, identified a triad of symptoms for diagnosis: deficits in social interaction and communication, repetitive behavior, and restricted interests. These symptoms vary among individuals, leading to diverse clinical presentations and treatment approaches. Therefore, considering the nuances of autism during assessment and treatment is essential [7].

Autism Spectrum Disorder (ASD), according to [18], comprises a set of behavioral characteristics affecting development, social skills, cognition, and communication in children. Signs typically manifest in early childhood, underscoring the importance of early diagnosis to provide support and developmental opportunities [7].

Individuals with Autism Spectrum Disorder (ASD) often experience coexisting health conditions such as epilepsy, depression, anxiety, and attention deficit hyperactivity disorder (ADHD). ASD is a developmental disorder that typically emerges in the first five years of life and may persist into adulthood. Healthcare professionals must be aware of these comorbidities to provide comprehensive and effective treatment [17].

INCLUSIVE EDUCATIONAL DESIGN

According to [16], "Inclusive design is approached as the design of products and environments that can be used by people of all abilities, with the primary objective of contributing to non-discrimination and social inclusion for all individuals."

Design is the art of communication, requiring a deep understanding of the user with whom the designer is communicating. The program, content, or device to be created must be self-explanatory and well-constructed, so that the contained objects are easy to interpret and understand [6].

In the context of Autism Spectrum Disorder (ASD), accessibility and communication become even more relevant. According to [16], in the United States, approximately 1 in every 54 children is diagnosed with ASD, underscoring the importance of considering solutions that meet the needs of this population.

Thus, educational design for individuals with ASD relates to the key strategies and guidelines of design that can be applied to ensure accessibility and usability of products and services tailored for these individuals. Educational design surpasses this description by leveraging principles from disciplines such as psychology, pedagogy, cognitive science, and human-computer interaction to develop captivating, learner-centered experiences. Therefore, it is a field focused on the systematic planning, development, and implementation of educational experiences that facilitate learners' acquisition of knowledge, skills, and competencies [10].

Keeping this in mind, one way to include users with ASD in educational content design would be through 9 categories: Layout, Content, Text, Images, Visual and Verbal Metaphors, Colors, Navigation, Interaction, and Customization[15], as illustrated in Table 1 below.

Table 1. Inclusive Design Categories for ASD.

Categories	Definitions

Layout	Individuals with autism often require consistency, clarity, and a well-defined structure. In user interface design, this translates into clear visual organization and consistent layout of information, which can help them focus on new information. An important principle is to group and highlight only the most frequently used features and controls, which can reduce the number of elements on complex pages and avoid user confusion [15][11].
Content	Content design for individuals with Autism Spectrum Disorder (ASD) requires special attention to ensure that information is easily understandable and accessible. Therefore, visual simplicity is prioritized, providing users with the visualization of short and flagged phrases, descriptive buttons, simple colors, and clear, direct language without slang, metaphors, or any figurative language.
Text	In text field design, it is recommended to follow the principle of simplicity, where the text box should be clearly distinguished from the rest of the content. Presenting the text box in a single left-aligned column using easy-to-read fonts is advisable. Additionally, well-defined sections and generous margins on a page also bring significant advantages [11].
Images	Findings from various studies on image perception by individuals on the autism spectrum have shown varied results. It is important to note that most of these studies were conducted with autistic children, especially in educational contexts. It has been observed that children with ASD tend to be visual learners, demonstrating a preference for learning through visual stimuli. Among the findings, the use of visual cues such as images and icons to assist in illustrating concepts stands out, resulting in improved reading comprehension. Therefore, it is recommended to include images close to the text to support understanding. Moreover, adopting simple graphics and avoiding the use of images as background for text helps to prevent unwanted distractions [11][13].
Visual and Verbal Metaphors	There are cognitive differences between neurotypical individuals and those with autism, one of which is Central Coherence. This skill involves the ability to understand the complete meaning from gathered details. It is noteworthy that individuals with autism have an exceptional ability to process information meticulously, but they may face challenges in understanding implicit meanings in language and social contexts. Additionally, studies indicate that individuals with autism do not always feel comfortable with metaphors and figurative language. Therefore, adopting clear language and avoiding navigation elements or buttons based solely on icons, without labels, except for the most common actions such as the "back" icon, is recommended. This approach benefits not only individuals with autism but also those from different cultural backgrounds or who do not have the native language [11][14]. Understanding these cognitive nuances and adopting an accessible and inclusive approach in communication is essential to ensure a positive experience for all individuals, considering their particularities and individual needs.
Colors	Regarding design principles and individuals with ASD, it is important to use soft and subtle colors in website design for autistic individuals. Furthermore, ensuring sharp contrast between text font and background is essential for conveying a clear and readable message [15][11][13].
Navigation	To provide greater comfort and control to individuals with autism during website use, several studies indicate that designers should simplify and clarify the navigation process, preferably through a single toolbar. Additionally, clearly labeling each page and providing a progress bar in flows that span multiple pages are fundamental. The use of large buttons with clear visual elements, combining icons and text, is recommended. It is important for buttons, links, and all interactive elements to have descriptive labels, such as "Attach file," avoiding expressions like "Click here" [11][13].
Interaction	Small details in website design can affect the user experience for individuals with autism. Research indicates that horizontal scrolling can be uncomfortable, while difficult-to-control animated elements can cause distraction and discomfort. Autoplay ads and sounds can trigger

	intense reactions in individuals with sensory sensitivity and anxiety. It is important to consider that 40% of individuals with autism have anxiety disorders, making these issues even more significant for them [15][11].
Customization	Thorough customization and rapid adaptation of documents according to user preferences are essential aspects to assist individuals with ASD. Features such as the ability to adjust font, size, spacing, colors, and themes in a document allow the user to engage in the design process, resulting in richer feedback. Moreover, this approach facilitates the reception of feedback from the client [15][13].

METHODOLOGY

This research aims to enhance communication and accessibility in the design field for individuals with ASD, in both educational and professional contexts, whether for academic group work among students or participation in professional project groups. This work is considered applied and qualitative research, focusing on the study of a specific tool. Additionally, a field study was conducted involving interviews and literature review. The following paragraphs outline the stages of the research.

Initially, a theoretical literature review was conducted on autism spectrum disorder, its characteristics, and the communication challenges associated with it. The aim was to identify existing technologies that could be adapted to facilitate neurodivergent individuals' understanding of feedback from teachers in academic projects or from professionals in senior roles in the job market, and also to achieve better communication with colleagues..

Subsequently, technologies were studied for their potential use and adaptation, leading to the development of a proposed technological tool for communication with individuals with ASD. Following this development phase, an interview was conducted with an expert in the field to identify specific characteristics necessary for adapting the technology to meet the proposed study's objectives.

Finally, in the third and last phase, the creation of an instructional tool is proposed based on an existing instrument, such as one found in Photoshop, aimed at improving communication and accessibility for professionals with ASD.

STICKY NOTES SUPPORTING ADAPTATION TO INDIVIDUALS WITH ASD

During this research, various image editing tools widely used by creative professionals were evaluated. After a thorough analysis of the pros and cons of each software, for methodological convenience, Adobe Photoshop was chosen. The choice of Adobe Photoshop was influenced by several factors, including its multilingual support, instant collaboration system ("share for review"), and the ability to add sticky notes directly to projects without external plugins. These features enhance usability and streamline communication among team members, such as colleagues, teachers, and supervisors, by allowing for quick feedback and information sharing within the software. Therefore, the following section describes how to add sticky notes to content and their alignment with principles of inclusive design (as shown in Table 1), enabling an adapted communication approach for individuals with Autism Spectrum Disorder.

THE STICKY NOTES TOOL

To utilize the proposed tool in this work, aimed at enhancing communication and accessibility for individuals with ASD in professional environments, a brief explanation for its use is provided, along with highlighted key points related to the nine categories as per Table 1.

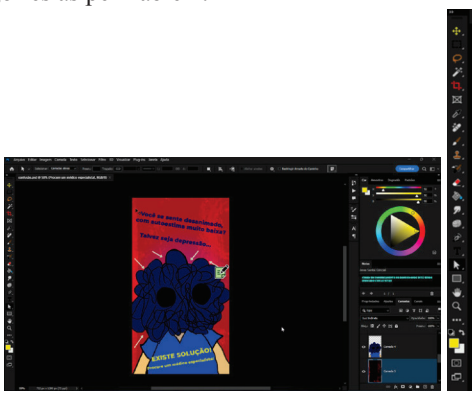

Figure 1. Main image with interface changes implemented (left) and changes in toolbar (right).

- Layout: Consistency and clarity are crucial in design for individuals with autism. Highlighting essential features reduces complexity and prevents confusion.
- Navigation: Simplifying navigation with a clear toolbar. Clear labels, progress bars, and large buttons are recommended.
- Interaction: Vertical scroll bar with colors that highlight important functions for neurodivergent interaction with the program interface. Also, reducing the apparent options, leaving only the most commonly used ones.

- Customization: Allowing the option to remove or pin tools according to the user's choice and needs, through a "CUSTOMIZATION" button in the top-right corner of the program, next to "SHARE."
- Images: Functions represented by images that facilitate user understanding.
- Content: Prioritizing visual simplicity is a challenge for Photoshop due to its presentation of numerous tools and a range of information to the user. Therefore, we proposed simplifying scroll bars, using vibrant colors, and signaling functions (through arrows). A beneficial approach, in a scenario for a novice user or similar, would be an in-software tutorial to introduce content to neurodivergent or neurotypical individuals.
- Text: Simple text boxes, highlighted and left-aligned, are recommended. Well-defined sections and generous margins bring advantages.
- Colors: The choice of vibrant colors that highlight specific functions or text is important for capturing the user's attention.
- Visual and Verbal Metaphors: Using unambiguous terms and direct communication, such as "Create a shading," pointing out the issue with arrows.

Figures 2 and 3 show the correct placement of sticky notes, pointed out with arrows and another change on the interface, providing a button for direct access to sticky notes. This made the use by individuals with ASD more clear and direct.

Figure 2. Placement of changes (indicated with arrows)**.**

Figure 3. Direct access to sticky notes

According to the reports presented in this and previous sections, we can understand that the inclusion of individuals with Autism Spectrum Disorder (ASD) in educational contexts, but especially in the corporate world, remains a challenge to be addressed. This challenge is exacerbated not only by the limited number of studies in this area but also by the relatively recent discovery and general unfamiliarity of the disorder among the population, hindering the development of new technologies that could facilitate the social and professional lives of these individuals.

Regarding the evaluation of the proposal, a face-to-face interview was conducted with a PhD specialist in the field who assessed the functionality and usability of the adapted tool. Precise information was gathered regarding the need for broader, clear, and functional social communication tools for individuals on the spectrum in the workplace, universities, schools, and broader social groups. The interview underscored that many of the points studied and described in this work from the perspective of inclusive design aligned with the expectations of the specialist in the field of Developmental Disorders. Therefore, it emphasizes the importance of studying software that provides predictability, organization, structure, technology-mediated interaction, and enhanced social integration for this particular audience.

FINAL REMARKS

This work presents an important initiative aimed at modifying interaction elements within Adobe Photoshop to enhance the use of Sticky Notes for individuals with Autism Spectrum Disorder (ASD). The goal is to provide effective support for clear feedback, improving communication with colleagues, teachers, and supervisors.

We proposed an inclusive design that creates an environment of anticipation, organization, and information for individuals with ASD. By studying Photoshop, we identified its user-friendly features and adapted specific functionalities to better suit the needs of this community.

Our approach emphasizes the adaptation of tools to promote the inclusion of autistic individuals in educational and professional settings. The use of Sticky Notes facilitates their understanding of this tool.

It's important to note that most existing studies are primarily theoretical, relying on interviews and reports from individuals with ASD.

Our work addresses this gap by offering a practical approach through software adaptation. We carefully considered nine fundamental categories for inclusive design—Layout, Content, Text, Images, Visual and Verbal Metaphors, Colors, Navigation, Interaction, and Customization—to ensure that the modified Photoshop Sticky Notes tool meets the specific needs of this community.

For future work, we recommend continuing this study to develop open-source software with similar functionalities, enabling not only individuals with ASD but also other neurodivergent individuals to share their projects and receive clear feedback through a new platform.

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