

LetraMania: A Game Design Analysis for Accessibility in Digital Games Targeting Children with Autism Spectrum Disorder

Luis Eduardo Rasch¹, Gabriel Moura de Sousa Guilherme¹, Daniela Alves de Azevedo³,
Ânderson dos Santos Ritta^{2,3}, Tatiana Tavares^{1,3}

¹ Ciência da Computação – Universidade Federal Pelotas (UFPel)
Pelotas – RS – Brasil

² Tecnologia em Análise e Desenvolvimento de Sistemas – Instituto Federal Sul-rio-grandense
Bagé – RS – Brasil

³ Programa de Pós-graduação em Computação – Universidade Federal Pelotas (UFPel)
Pelotas – RS – Brasil

lerasch@inf.ufpel.edu.br, gabrielmsg@insiberia.net, daazevedo@inf.ufpel.edu.br

andersonritta@gmail.com, tatiana@inf.ufpel.edu.br

Abstract. Introduction: Digital games designed for children with Autism Spectrum Disorder (ASD) must address challenges related to cognitive load, sensory sensitivity, and interaction predictability, which are often not fully considered in existing solutions. **Objective:** This work presents a game design analysis of LetraMania, an educational game focused on word formation, aiming to evaluate how its mechanics and interaction design support accessibility for neurodivergent users. **Steps:** The analysis examines core aspects of the system, including interaction mechanics, interface design, multimodal feedback, difficulty progression, and behavioral metric collection, grounding the discussion in literature on serious games and accessibility. **Expected Results:** The study identifies design decisions aligned with ASD user needs, such as simplicity, consistency, and immediate feedback, while also highlighting limitations in adaptability, sensory control, and personalization. The results contribute a set of design guidelines to support the development of more accessible digital games for neurodivergent audiences.

Keywords: Autism Spectrum Disorder (ASD), Serious Games, Game Accessibility, Game Design, Cognitive Load, Neurodivergent Users

1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by differences in social communication, behavior, and sensory processing [American Psychiatric Association 2013]. When developing a digital system intended for users with ASD, such as software applications and, in particular, digital games, these differences need to be addressed by making adaptations to the user interface. However, the heterogeneity of the spectrum poses challenges for the development of these adaptations, which must accommodate diverse cognitive and sensory profiles.

Games designed with a purpose other than just entertainment, known as "serious games", have shown potential as tools to support learning and intervention for children with ASD, due to features such as controlled environments, predictable rules, and immediate feedback [Wang et al. 2025, Grossard et al. 2017]. However, many existing solutions still fail to address key accessibility requirements, including cognitive load management, sensory regulation, and adaptability [Serna et al. 2022].

This paper details the design process of *LetraMania* [Rasch et al. 2026]. The main objective of the study is to describe and systematize the design of the game, with emphasis on its interaction design decisions, feedback strategies, and accessibility requirements. The design process was guided by principles of clear interaction, reduced cognitive ambiguity, and adaptation to different levels of sensory sensitivity and error tolerance.

Overall, this study frames *LetraMania* as a designed interactive system, identifying key design decisions, strengths, and limitations, and positioning them as contributions to the knowledge base of accessible serious game design for neurodivergent users.

2. Goal

The goal of *LetraMania* is to design an educational and accessible game experience for children with Autism Spectrum Disorder (ASD), supporting early literacy through word formation tasks based on image association. The system is built to promote the connection between visual stimuli and written language while maintaining low cognitive load, predictable interaction patterns, and reduced sensory stress.

From a design perspective, the project prioritizes clarity of interaction, immediate and consistent feedback, and configurable levels of challenge, avoiding unnecessary complexity that could negatively impact usability for ASD players. Additionally, the game includes data collection mechanisms to record player performance, enabling its use as a support tool in pedagogical and clinical contexts.

Beyond the development of the game itself, this work aims to analyze *LetraMania* from a game design perspective, focusing on how its mechanics, feedback systems, and interaction structure address the specific needs of children with ASD. The objective is to identify effective design decisions, highlight current limitations, and contribute guidelines for the development of accessible digital games for neurodivergent audiences.

3. Steps

The development of *LetraMania* is guided by accessibility constraints for children with Autism Spectrum Disorder (ASD), focusing on predictable interaction, low cognitive load, and minimal ambiguity.

The system is implemented in the *Godot* game engine and structured around a drag-and-drop mechanic, where players complete words by placing letters into predefined slots based on an associated image. Letters (correct and distractors) are dynamically generated and validated through position and value matching.

Interaction with gameplay elements has been reduced to a single primary action, contributing to the system's usability, specifically regarding efficiency and ease of

learning [Nielsen e Loranger 2007]. This direct interaction is essential in the context of a young audience, as children in the early stages of literacy have limited capacity to execute complex sequences of actions [Liu 2018]. Furthermore, the touch-and-drag gesture is simple, fundamental for children under nine years old, as it does not require fine motor coordination [Liu 2018]. In addition, the interface prioritized only the elements relevant to the task, in order to reduce extrinsic cognitive load [Sweller 2020, Falcade et al. 2025]. Although the current implementation may display a considerable number of letters simultaneously, these elements are visually simple and essential for performing the activity.

The interface elements follow a visual pattern, in which elements with the same function have the same size, typography, color, and graphic style. This standardization contributes to the system's consistency, being fundamental to avoid confusion and facilitate the memorization of the elements' function [Rogers et al. 2013, Rogers et al. 2013]. Furthermore, an uppercase sans-serif typeface was used to make the letters more familiar and recognizable for children in the literacy process [Fabossi 2014].

Support mechanics include hints, configurable error tolerance, and immediate feedback, with global settings allowing partial control over music, score visibility, and timers.

Progression is based on increasing word length (4–6 letters), with words randomly sampled from predefined image-word datasets. Gameplay metrics are logged and exported for external analysis.

3.1. Gameplay Mechanics and Support Systems

The **core loop** consists of observing an image, selecting a letter, placing it via drag-and-drop, and receiving immediate feedback. This structure ensures a direct action-result mapping and reduces ambiguity [Costello e Donovan 2019]. The drag-and-drop interaction supports spatial correspondence tasks such as letter placement [Stöckel et al. 2021].



Figura 1. A game where the player has already progressed to a certain point with some letters already placed in their respective spaces.

The **difficulty progression** follows increasing word length (4, 5, and 6 letters), introducing a simple and predictable growth in task complexity.

The **life system** allows configurable error tolerance, including an infinite mode.

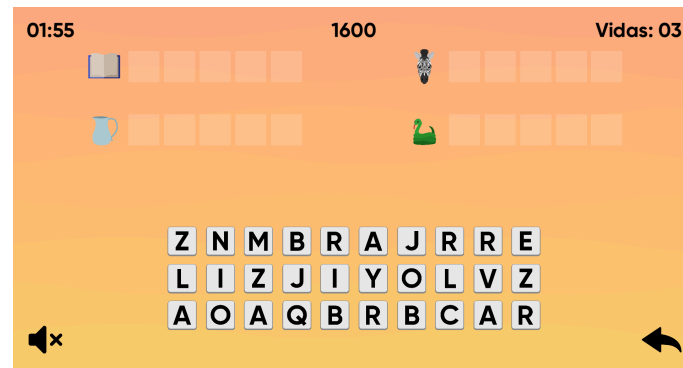


Figura 2. As the game progresses, the player needs to complete longer words.

This reduces performance pressure and supports exploratory interaction, particularly for users sensitive to failure [Sadrudin 2025].

The **hint system** is triggered by inactivity, highlighting the correct position and letter. This reduces the need for explicit help requests, but is limited to a single level of assistance [Rezayi et al. 2025].



Figura 3. The hint system being triggered

The **feedback system** combines visual, auditory, and numerical responses to reinforce actions. However, it lacks independent control over sensory channels, which may affect users with hypersensitivity [Matsuda et al. 2025, Rezayi et al. 2025].

The **metrics system** records errors, inactivity time, and performance across phases. These data support external analysis by educators and therapists, although they are not yet used for adaptive gameplay [Liu et al. 2025, Melo et al. 2025].

4. Expected Results

The design of *LetraMania*, grounded in principles of accessibility, cognitive load management, and sensory regulation, is expected to produce positive outcomes in engagement, usability, and learning support for children with Autism Spectrum Disorder (ASD).

By prioritizing predictable interaction patterns, immediate feedback, and reduced performance pressure, the system is expected to facilitate task comprehension and sustained engagement. The combination of a clear objective, direct manipulation



Figura 4. Different options can be adjusted to offer an adapted user experience

mechanics, and consistent feedback loops should support the development of basic orthographic skills, particularly in the association between visual stimuli and written language.

From a behavioral perspective, the game is expected to reduce frustration and task abandonment, especially when configured in low-pressure modes such as infinite lives. The presence of automatic assistance mechanisms is also expected to minimize prolonged inactivity periods, contributing to smoother interaction flow and increased task completion rates.

In terms of cognitive processing, the structured progression and simplified interaction model are expected to help maintain attention and reduce extraneous cognitive load. However, due to the absence of adaptive difficulty and fine-grained sensory customization, performance variability across different ASD profiles is expected, particularly in scenarios involving higher visual density or increased task complexity.

Another aspect that may impact performance and the overall user experience is the current lack of adaptations focused on the wide variety of hyperfocuses that may be present in a group of players with different ASD profiles. It is expected that a game with generic and uncorrelated words will not be enough to capture the attention of the majority of players in a neurodivergent user group.

The integration of gameplay metrics positions the system as a tool not only for interaction but also for observation. It is expected that the collected data will enable the identification of patterns related to attention, error recurrence, and engagement, supporting external analysis by educators and therapists.

Overall, *LetraMania* is expected to function effectively as a structured and accessible educational tool, particularly in mediated or supervised contexts. At the same time, its current limitations indicate that further improvements in adaptability, personalization, and sensory control are necessary to ensure broader applicability across the full heterogeneity of the ASD spectrum.

Future work should focus on empirically validating these expectations through user studies, correlating interaction metrics with observed behavioral outcomes, and assessing the impact of proposed design improvements.

Referências

- American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders: DSM-5*. Washington, DC, 5 edition.
- Costello, R. e Donovan, J. (2019). How game designers can account for those with Autism Spectrum Disorder when designing game experiences. *International Journal of End-User Computing and Development*, 8(2):29–55.
- Fabossi, L. A. (2014). Design de aplicativo para tablets para crianças em educação infantil.
- Falcade, A., Abegg, I., e Falcade, L. (2025). Teoria da carga cognitiva: Aproximação de ideias e conceitos. *Inter-Ação*, 45(3).
- Grossard, C. et al. (2017). Serious games to teach social interactions and emotions to individuals with autism spectrum disorders. *Computers & Education*, 113:195–211.
- Liu, F. (2018). Children’s cognitive development and implications for digital design.
- Liu, Z. et al. (2025). Framework for adaptive multimodal serious games for early intervention of autistic children. *Computers & Education: Artificial Intelligence*, 8.
- Matsuda, S. et al. (2025). Eggly: Designing mobile augmented reality neurofeedback training games for children with autism spectrum disorder. *arXiv preprint arXiv:2503.04984*.
- Melo, A. et al. (2025). Towards serious games through a playful approach for children with autism spectrum disorder. *International Journal of Child-Computer Interaction*, 44.
- Nielsen, J. e Loranger, H. (2007). *Usabilidade na web*. Elsevier, Rio de Janeiro. Tradução de Edson Furmankiewicz e Carlos Schafranski. 3. reimpressão.
- Rasch, L. E., Guilherme, G. M. S., Pinho, R. M. d., Santos, P. B. d., Tavares, T. A., Cassuriaga, T. V., e Ritta, S. (2026). Letramania: Inovação digital em saúde e educação inclusiva para pessoas com transtorno do espectro autista (tea). *Anais do Computer on the Beach*.
- Rezayi, S. et al. (2025). Impact of a serious games-based adaptive learning environment on developing communication skills and motivation among autistic children. *Education and Information Technologies*.
- Rogers, Y., Sharp, H., e Preece, J. (2013). *Design de interação*. Bookman, Porto Alegre, 3 edition.
- Sadrudin, M. M. (2025). Empowering learners with autism spectrum disorder (asd) through gamification. In *Gamification and Inclusion*. Springer, Cham.
- Serna, A. et al. (2022). Method for the development of accessible mobile serious games for children with autism spectrum disorder. *Applied Sciences*, 12(7):3659.
- Stöckel, S. et al. (2021). Interaction styles in context: Comparing drag-and-drop, point-and-touch, and touch in a mobile spelling game. *International Journal of Human-Computer Interaction*, 37(9).
- Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, 68:1–16.

Wang, Z. et al. (2025). The effect of game-based interventions on children and adolescents with autism spectrum disorder: A systematic review and meta-analysis. *Frontiers in Pediatrics*, 13.