REVISTA CEREUS
ISSN: 2175-7275

DOI 10.18605/2175-7275/cereus.v18edicaoespecialp330-342

Recebido em: 22/01/26
Aceito em: 24/04/26

ARTIGO

DEVELOPMENT AND USABILITY EVALUATION OF AN INFORMATIVE WEB PLATFORM ABOUT DOWN SYNDROME: A CASE STUDY IN DOURADOS-MS

DESENVOLVIMENTO E AVALIAÇÃO DE USABILIDADE DE UMA PLATAFORMA WEB INFORMATIVA SOBRE SÍNDROME DE DOWN: ESTUDO DE CASO EM DOURADOS-MS

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ABSTRACT

Introduction: Down Syndrome (DS) affects the physical and cognitive development of thousands of people, whose families and caregivers often face difficulties accessing reliable information and specialized resources. **General Objective:** This study presents the development and validation of the InfoSD web platform, dedicated to disseminating information about DS in the Dourados-MS region. **Material and methods:** This involved developing a platform that offers accessible, practical resources for families, educators, and healthcare professionals, including an interactive map of specialized clinics (built with Leaflet.js and geolocation APIs), a library of educational materials, educational games, and a chatbot for automated support. **Results and discussion:** The system was developed using Vue.js and Quasar Framework, with data management via Supabase. Usability validation, conducted with 33 participants from the region using the System Usability Scale (SUS) methodology, resulted in an average score of 87.42 points, classifying the platform as “Excellent” and confirming high effectiveness, efficiency, and user satisfaction. **Final considerations:** The results demonstrate that 69.7% of participants rated the system at 85 or higher, highlighting the solution's potential to promote digital inclusion and facilitate access to health information in the region.

Keywords: Down Syndrome; Web platform; Usability; Digital inclusion; System Usability Scale.

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RESUMO

Introdução: A Síndrome de Down (SD) afeta o desenvolvimento físico e cognitivo de milhares de pessoas, cujas famílias e cuidadores frequentemente enfrentam dificuldades para acessar informações confiáveis e recursos especializados. **Objetivo Geral:** Este estudo apresenta o desenvolvimento e validação da plataforma web InfoSD, dedicada à disseminação de informações sobre SD na região de Dourados-MS. **Material e métodos:** Tratou-se do desenvolvimento de uma plataforma que oferece recursos acessíveis e práticos para famílias, educadores e profissionais da saúde, incluindo: mapa interativo de clínicas especializadas (implementado com Leaflet.js e APIs de geolocalização), biblioteca de materiais educativos, jogos educativos e chatbot para suporte automatizado. **Resultados e discussão:** O sistema foi desenvolvido com Vue.js e o Quasar Framework, com gerenciamento de dados via Supabase. A validação de usabilidade, conduzida com 33 participantes da região por meio da metodologia System Usability Scale (SUS), resultou em escore médio de 87,42 pontos, classificando a plataforma como “Excelente” e confirmando alta efetividade, eficiência e satisfação dos usuários. **Considerações finais:** Os resultados demonstram que 69,7% dos participantes avaliaram o sistema com escores superiores a 85 pontos, evidenciando o potencial da solução para promover inclusão digital e facilitar o acesso à informação em saúde na região.

Palavras-chave: Síndrome de Down; Plataforma web; Usabilidade; Inclusão digital; System Usability Scale.

1. INTRODUCTION

Down syndrome (DS) is a genetic alteration caused by an extra copy of chromosome 21, resulting in three copies instead of the usual two. This condition, also known as trisomy 21, affects the physical and cognitive development of the individual (Antonarakis et al., 2020; Movimento Down, 2012). The causes of DS are related to errors in cell division during the formation of the egg, sperm, or embryo in its early stages. Although the condition may be associated with several risk factors, such as advanced maternal age, it is important to emphasize that DS is not caused by any parental behavior or environmental factor (Silva, Dessen, 2002).

The first clinical description of the characteristic signs of people with Down syndrome occurred in 1866, by physician John Langdon Down, who worked at the Earlswood Asylum in England, where he cared for children with a specific type of cerebral palsy. After a long period of observation, Down began to notice that these children shared common characteristics, from appearance to motor coordination. At that time, Down syndrome was called “mongolism” (Longo, 2025). As the term mongolism is considered pejorative, the term Down syndrome came to be used (Marques; Siqueira, 2023). After ten years of work at the asylum, John resigned from his position and, in 1868, created his own institution for children with “mental disabilities” in Teddington, England. Down died in 1896 from an illness he had acquired (Longo, 2025).

The characteristics of Down syndrome range from mild to severe intellectual difficulties, as well as some physical challenges, such as hypotonia (reduced muscle tone) and delayed motor development (Nisihara et al., 2014). The phenotypes, the set of observable characteristics, that involve Down syndrome can manifest multiple bodily symptoms in general, such as musculoskeletal symptoms, which are muscle injuries; neurological symptoms, which interfere with the functioning of the central and peripheral nervous system; and cardiovascular symptoms, which affect the circulatory system of the heart and blood vessels (Antonarakis Et Al., 2020; Pietricoski; Della Justina, 2023). Other common symptoms include short stature, muscle hypotonia, atlantoaxial instability, reduced neuronal density, cerebellar hypoplasia, intellectual disability, congenital heart defects, and atrioventricular septal defect.

In this context, a web platform called InfoSD was developed, dedicated to Down syndrome and focused on the Dourados-MS region. This initiative aimed to provide

accessible and centralized information, promoting awareness and inclusion of the local population. The platform not only educates but also provides detailed educational resources about the characteristics of the syndrome and ways to support individuals with Down syndrome.

The development of InfoSD, focused on Down Syndrome and especially geared towards Dourados and the surrounding region, aims to aggregate existing resources, including those offered by local and national websites. Unlike these initiatives, the InfoSD platform brings together relevant content from these services and offers additional functionalities tailored to the specific needs of families, caregivers, and professionals in the region. The platform integrates an interactive map with multiple points of specialized clinics, institutions, and educational games, resources that make navigation more dynamic and learning more accessible (Silva, 2022).

The objective of this study is to present the development of a web platform focused on Down syndrome (DS) in the Dourados-MS region, offering support and information to individuals with the condition, their families, healthcare professionals, and the general public. The platform aims to raise awareness and provide practical content and guidance on daily care and social inclusion. To this end, *frameworks were used* to ensure an accessible, attractive, and interactive interface. Furthermore, this work aims to evaluate the platform's usability using the *System Usability Scale* (SUS), a widely recognized and validated instrument for measuring user experience in digital systems. The usability evaluation was conducted with 33 participants from the Dourados-MS region to assess the effectiveness, efficiency, and user satisfaction with the developed platform, thereby contributing to the improvement of technological solutions focused on digital inclusion and access to health information.

2. MATERIALS AND METHODS

The development of the platform followed a structured approach, aiming to ensure the quality and relevance of the content made available. This research was submitted to and approved by the Research Ethics Committee of the State University of Mato Grosso do Sul, as per Certificate of Presentation for Ethical Review (CAAE) No. 84586324.9.0000.8030. All participants signed the Informed Consent Form (ICF), and data collection was conducted in accordance with CNS Resolution No. 466/2012. This step was essential for administering a questionnaire to the research participants.

A supplementary literature review was conducted to identify reliable sources of information on Down syndrome (DS). This process involved analyzing scientific articles, documents from specialized organizations, and publications from medical institutions. All selected content underwent verification to ensure that the information provided on the platform was secure, up to date, and accessible to the target audience. Based on the theoretical review and the proposed objectives, the system was planned. The platform was built using the *Vue.js framework* via *the Quasar Framework*, in conjunction with *JavaScript. The Leaflet.js* library (Leaflet Team, 2025) was used to implement interactive maps that visualize and register clinics linked to the SD.

In order to optimize the handling of addresses and geolocation, two external APIs were integrated: the *ViaCEP API* (VIACEP, 2025), responsible for validating and querying address information from the postal code, and the *Nominatim API* (Openstreetmap Project, 2025), used to convert addresses into geographic coordinates (geocoding). This integration ensured greater accuracy in mapping clinics and facilitated user navigation on the platform.

Regarding automated interaction, *Chatbase* (Chatbase Team, 2025) was chosen, a *chatbot solution* that allows for dynamic and accessible user support. The tool was selected for its flexibility, ease of integration with web applications, and ability to quickly answer common questions. As for the database, the system was modeled with a relational database managed by *Supabase* (Supabase, 2025). The system incorporates a *chatbot* for automated support and has been published on *Netlify* for access during testing and validation (Netlify, 2025). The project has been fully developed and tested with users, but is not yet available online at the time of publication. It is expected to be made publicly available in the future.

Recruitment of the 40 participants was conducted entirely remotely via WhatsApp. Potential participants received an introductory message outlining the study's objective, which was to evaluate the ease of use of the web platform, and an invitation to access and subsequently complete the questionnaire. It is important to note that the research was conducted independently, without the direct or intermediary involvement of formal institutions such as schools or hospitals.

Data collection was conducted remotely using a structured questionnaire on Google Forms. The link to access the form was provided via WhatsApp, along with an explanatory message and a reaffirmation of the importance of the Informed Consent Form.

The usability questionnaire used was the System Usability Scale (SUS), translated and validated for Brazilian Portuguese by Lourenço et al. (2022). This instrument consists

of 10 questions using a Likert scale from 1 to 5, where 1 represents “Strongly Disagree” and 5 represents “Strongly Agree”. This methodology is widely used to evaluate the usability of digital systems, allowing for standardized comparisons.

To obtain the final score (SUS score), the individual responses of the 33 participants were converted according to the nature of the question:

- For odd-numbered questions (positive: Q1, Q3, Q5, Q7, and Q9): The score is the answer value minus 1, resulting in a value between 0 and 4.
- For even-numbered questions (negative: Q2, Q4, Q6, Q8, and Q10): The score is 5 minus the value of the answer, resulting in a value between 0 and 4.

The converted scores for each participant were summed. The average of this sum across all participants was multiplied by 2.5, as per (Lourenço et al., 2022).

3. RESULTS AND DISCUSSION

The InfoSD platform was developed to centralize information on DS and provide practical resources for the Dourados-MS region. The development was guided by detailed requirements, divided into Functional and Non-Functional aspects.

The Functional Requirements (FR) focused on essential functionalities, such as (FR01, FR03) the registration of professionals and clinics/hospitals (subject to administrative moderation) and (FR04, FR10) the display and location of clinics through an interactive map with geolocation. Other mandatory functions included (FR05, FR07, FR08) the provision of educational games, the offering of updated scientific content (via RSS feeds), and (FR09) the implementation of a chatbot for support. The function of (FR06) generating PDFs containing the clinic locations was also established as mandatory.

Non-Functional Requirements (NFRs) define the quality attributes that ensure a good user experience. The system was designed to have an (NFR01) Intuitive and accessible interface. (NFR02) Responsiveness and compatibility across mobile and desktop devices were mandatory, and (NFR03) Response time for system actions was limited to 10 seconds.

The system was implemented using *Vue.js* and *Quasar Framework* , with data management via *Supabase* and *a full-stack architecture* (VUE.JS Team, 2025; QUASAR Framework, 2025; Supabase, 2025). The platform integrates functionalities such as an interactive map of specialized clinics (implemented with *Leaflet.js*), a library of educational materials via RSS *feeds* , educational games, and a chatbot for automated support.

Figure 1. Part of the InfoSD platform's home screen**.**
Source: (prepared by the authors)

As shown in Figure 1, the platform was structured into logically and accessibly organized sections, focused on medical and scientific information and contact details for specialized clinics. The main functionalities implemented include: (i) a registration and authentication system with distinction between conventional and professional profiles; (ii) an interactive map with geolocation of specialized clinics, using the *ViaCEP* and *Nominatim APIs* for address validation and conversion into geographic coordinates; (iii) automatic address completion via postal code; (iv) a section of educational games focused on cognitive development; (v) a library with scientific articles and educational materials; (vi) a system for exporting data in PDF format; and (vii) an administrative area for moderating clinic registrations.

The differentiating factor of InfoSD compared to existing initiatives, such as “DouraDown” (Douradown, 2025), “Mano Down” (Mano Down, 2025), and “Movimento Down” (Movimento Down, 2025), lies in the integration of multiple functionalities into a single platform with a regional focus. The registration moderation system is fundamental to maintaining the integrity of the information, preventing incorrect or duplicate registrations and ensuring reliability for users seeking specialized services. The integrated visualization across cards and maps facilitates navigation, while PDF export enables offline sharing of

information. Figure 2 presents the interactive map with detailed information on registered clinics.

Figure 2. Interactive map showing information on specialized clinics.

Source: (prepared by the authors)

A section featuring educational games for the DS audience was included to promote cognitive development in a playful, interactive way. Four different types of games were made available for any user. The platform also provides a library with scientific articles, guides, and educational materials about DS, integrated via RSS feeds (Figure 3).

Following the development of the InfoSD platform, an evaluation phase was conducted with the population of Dourados-MS. For this purpose, 40 people were invited, 20 with direct contact with people with Down syndrome (family members, caregivers, or professionals) and 20 without such contact. Between August 15th and 31st, 2024, 33 participants responded to the questionnaire, representing a response rate of 82.5%. All participants who completed the questionnaire agreed to the Informed Consent Form, resulting in 100% acceptance.

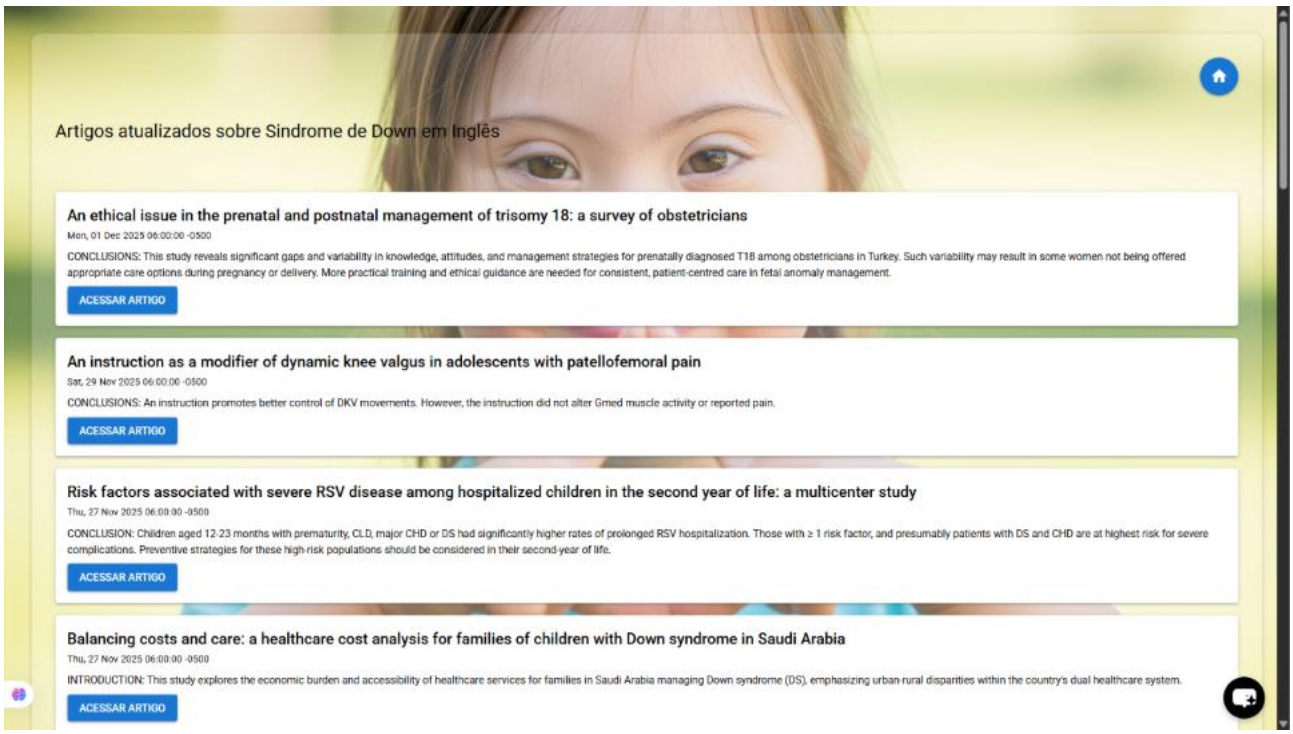

Figure 3. Library section of the InfoSD platform.

Source: (prepared by the authors)

The results demonstrated high acceptance of the platform across all evaluated aspects. In Question 1 (Q1), regarding frequency of use, 90.9% of participants indicated they would use the site frequently (48.5% strongly agreed and 42.4% agreed), while 9.1% remained neutral, and no respondents disagreed. In Question 2 (Q2), 97% of participants found the information clear and easy to understand, disagreeing with the statement that the site presents difficult-to-understand information (69.7% strongly disagreed and 27.3% disagreed). In Question 3 (Q3), 97% agreed that the site is easy to understand and use (69.7% strongly agreed and 27.3% agreed), with only 3% strongly disagreeing.

Questions 4 through 8 assessed operational aspects of the platform. In Q4, 87.9% of participants indicated they did not need help using the site (75.8% strongly disagreed and 12.1% disagreed). In Q5, 93.9% rated the integration of functionalities positively (60.6% strongly agreed and 33.3% agreed). In Q6, 84.9% did not perceive any significant errors or difficulties (66.7% strongly disagreed and 18.2% disagreed). In Q7, 100% of participants agreed that it is possible to learn how to use the site quickly (69.7% strongly agreed and 30.3% agreed). In Q8, 87.9% considered the platform clear and objective, disagreeing with the statement that the site is confusing (78.8% strongly disagreed and 9.1% disagreed). In Question 9 (Q9), 100% of participants demonstrated confidence in using the platform (66.7%

strongly agreed and 33.3% agreed), with no neutral or dissenting responses. In Question 10 (Q10), 72.7% of users disagreed that they needed extra time to understand how the site worked, demonstrating that its use was intuitive for most participants.

In addition to quantitative questions, 18 participants provided qualitative feedback on the experience. Responses highlighted positive aspects such as content clarity, ease of navigation, and the platform's social relevance. Suggestions for improvement included: (i) greater emphasis on physiotherapy materials; (ii) creation of a specific games section; and (iii) spelling revision of some texts. These observations corroborate the generally positive reception and offer concrete avenues for future improvement.

The SUS score was calculated according to the established methodology by converting individual responses and multiplying the average by 2.5. The final average score was 87.42, placing the system in the “Excellent” category according to usability *benchmarks*. This result positions the InfoSD platform among systems with high usability acceptance. This result aligns with the high performance observed in other digital solutions in the health context, such as the speech training application (89.2 points). It is close to the lip rehabilitation device (91.1 points) and to systems with good acceptability, such as the Neonatal Health Information System (73.3 points), all evaluated with the SUS scale (Barroso, 2025; Padrini-Andrade et al., 2019). The score obtained is well above the cutoff of 68.00, confirming the high usability perceived by users (Sauro, 2011).

As detailed in Table 1, the average score of 87.42 points and the median of 92.50 points both reinforce the solution's success. The median is higher than the average, indicating that most participants rated the system highly, with 50% assigning 92.50 points or more. The standard deviation of 13.66, despite the wide range between the minimum (50.00) and maximum (100.00) scores, demonstrates good consistency in the positive responses, corroborating the high usability of the system.

Table 1. Main Statistics from the SUS Evaluation of the InfoSD Platform.

Statistical metric	Value
Average SUS Score	87.42 points
Median (50th Percentile)	92.50 points
1st Quartile (25th Percentile)	82.50 points
3rd Quartile (75th Percentile)	97.50 points
Standard Deviation	13.66 points

Minimum Score	50.00 points

Source: (prepared by the authors)
Legend: Average SUS Score: Average perceived usability (0-100), used for overall classification; Median (50th Percentile): The central value of the scores (top 50%); 1st Quartile (25th Percentile): The value separating the lowest 25%; 3rd Quartile (75th Percentile): The value separating the highest 25%; Standard Deviation: Variation and consistency of scores in relation to the average; Minimum Score: The lowest individual score recorded.

The result of 87.42 points for InfoSD, associated with the consensus that it is possible to learn quickly (100% agreement) and that the system does not require technical assistance (87.9% disagreed), attests to the high intuitiveness and success of the web design. This stands out in comparison to the study by Barroso et al. (2025), with more intrusive solutions, such as the lip rehabilitation device, which, despite achieving a high SUS score (91.1 points), generated disagreement in the questions that assess the complexity and the need to learn a lot of information before use.

4. FINAL CONSIDERATIONS

This study presented the development of the InfoSD web platform, dedicated to disseminating information about Down Syndrome in the Dourados-MS region, and its validation using the *System Usability Scale* (SUS) methodology. The project integrated technology and social inclusion, resulting in a functional solution that centralizes reliable information, educational resources, and support tools for people with Down Syndrome, their families, healthcare professionals, and the general public.

The platform was developed using technologies including *Vue.js*, *Quasar*, *JavaScript, and the Supabase* relational database*. The implemented full-stack* architecture enabled the creation of a responsive, accessible interface with specific functionalities that meet the needs of the target audience. The differentiating factors of the InfoSD platform from existing initiatives are its regional and integrated approach.

The results from applying the SUS scale demonstrated high platform acceptance. A score of 87.42 points classifies the system as “Excellent”. The distribution of individual scores, which presented a median of 92.50 points and a standard deviation of 13.66 points, reinforces this result. The positive results indicate that the platform meets the requirements of effectiveness, efficiency, and user satisfaction.

As future perspectives, it is recommended to implement an evaluation and *feedback system* that allows users to assess resources, services, and content, providing continuous data for improvement. Creating a discussion forum or *online community* would allow family

members, professionals, and caregivers to share experiences and build a network of mutual support. Including information on the health insurance plans accepted by registered clinics would facilitate user research and selection. At the time of publication, the InfoSD platform was not publicly available. There is future interest in making it publicly accessible.

5. ACKNOWLEDGEMENTS

Acknowledge the financial support of the Fundação de Apoio ao Desenvolvimento do Ensino, Ciência e Tecnologia do Estado de Mato Grosso do Sul (FUNDECT).

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