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Systematic Review

Evaluation of User Experience and Functional Adequacy in Mobile Applications for Rehabilitation: Systematic Review

Evaluación de la experiencia de usuario y la adecuación funcional en aplicaciones móviles de rehabilitación. Revisión sistemática

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Abstract

Introduction. Mobile rehabilitation applications offer benefits such as accessibility, cost reduction, and increased patient engagement, but they face quality challenges, including unfriendly interfaces and deficient functionalities. This systematic review examines the quality of these applications in terms of Functional Suitability and User Experience.
Objective. To evaluate the compliance of mobile rehabilitation applications with the ISO/IEC 25010 standard, focusing on User Experience and Functional Suitability in areas such as physiotherapy, speech therapy, and occupational therapy.
Method. A systematic literature review following the PRISMA framework. Relevant studies from 2019 to 2023 were identified and evaluated for methodological quality using CASP and MMAT. Approved studies were analyzed to verify the compliance of the applications with the ISO 25010 standard, using a mixed-method approach combining qualitative and quantitative assessments of User Experience and Functional Suitability, supported by collaborative tools such as Rayyan, Google Sheets, and researcher consensus.
Results. The study shows that mobile rehabilitation applications do not report a high level of quality according to the criteria of the ISO/IEC 25010 standard. Slightly more than half declare compliance with functional suitability (56.9%), and only 38.2% report compliance with User Experience.
Conclusions. To improve User Experience, it is recommended to simplify interfaces, include educational content, and provide customization options. Regarding Functional Suitability, there is a need to enhance communication between patients and professionals, expand the needs covered, and update algorithms for more personalized treatments.
Keywords. Mobile applications, telerehabilitation, physiotherapy, speech therapy, occupational therapy.

Resumen

Introducción. Las aplicaciones móviles de rehabilitación ofrecen beneficios como accesibilidad, reducción de costos y mayor participación del paciente; sin embargo, enfrentan desafíos de calidad como interfaces poco amigables y funcionalidades deficientes. Esta revisión sistemática examina la calidad de estas aplicaciones en términos de adecuación funcional y experiencia de usuario.

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Objetivo. Evaluar la conformidad de las aplicaciones móviles de rehabilitación con el estándar ISO/IEC 25010, centrándose en la experiencia de usuario y la adecuación funcional en áreas como fisioterapia, fonoaudiología y terapia ocupacional.
Métodos. Se realizó una revisión sistemática de la literatura siguiendo el protocolo de la declaración PRISMA. Se identificaron y evaluaron estudios relevantes con calidad metodológica (2019-2023) mediante CASP y MMAT. Los estudios aprobados fueron analizados para verificar la conformidad de las aplicaciones con la norma ISO 25010 utilizando un enfoque mixto de evaluación cualitativa y cuantitativa de la experiencia de usuario y la adecuación funcional, apoyados por herramientas colaborativas de Rayyan, una hoja de cálculo y el consenso de los investigadores.
Resultados. El estudio muestra que las aplicaciones móviles de rehabilitación no reportan buen nivel de calidad de acuerdo con los criterios del estándar ISO/IEC 25010. Un poco más de la mitad declara cumplimiento de adecuación funcional (56.9%) y solo 38.2% reporta cumplimiento en la experiencia de usuario.
Conclusiones. Para mejorar la experiencia de usuario se recomienda simplificar las interfaces e incluir contenido educativo y opciones de personalización. En cuanto a la adecuación funcional, es necesario mejorar la comunicación entre pacientes y profesionales, ampliar las necesidades cubiertas y actualizar algoritmos para tratamientos más personalizados.
Palabras clave. Aplicaciones móviles, telerehabilitación, fisioterapia, fonoaudiología, terapia ocupacional.

Introduction

Today, more than 3.8 billion people in the world use smartphones. This has boosted the use of mobile applications in areas such as rehabilitation,[1] These solutions improve accessibility, reduce treatment costs by 30% and allow patients to actively participate in their recovery.[2,3] However, many of these applications are quickly abandoned due to their low quality. This is due to unintuitive interfaces, complicated navigation and inefficient functionalities that do not meet user expectations.[4,5]

To raise the quality of mobile rehabilitation applications, it is essential that the design and implementation of the software focus on the needs of the users.[6] Features such as functional suitability, performance efficiency, compatibility, User Experience, reliability, security, maintainability and portability are crucial to guarantee high quality solutions.[7] Some research that has addressed the use of mobile applications in rehabilitation has focused on the impact on patients' health. This have left the quality evaluation of the own features of the application in the background.

This systematic review explores the User Experience and Functional Suitability of mobile rehabilitation applications, with the objective of verifying their alignment with the ISO/IEC 25010 quality standard.[7] To fulfill this purpose, the identification and selection of relevant studies in the scientific literature are proposed as specific objectives, together with the rigorous evaluation of their methodological quality, in order to analyze the conformity of the applications with the aforementioned standard.

The analysis of this research was performed through systematic searches in Google Scholar, PubMed and university digital libraries, covering the period 2019-2023 in the areas of physiotherapy, occupational therapy and speech therapy in patients with multiple pathologies. The selected studies, managed with Rayyan collaborative tools, Google spreadsheet and the consensus of the researchers, were focused on the user experience and the functional suitability of the applications, excluding those focused solely on clinical effectiveness. Subsequently, their methodological quality was assessed using the CASP[8] and MMAT[9] checklists, retaining only the most rigorous studies.

Finally, a mixed analysis was performed, integrating qualitative and quantitative evaluations, to determine the compliance of the applications with the ISO/IEC 25010 standard. This approach not only allowed to evaluate the user experience and functional suitability, but also to offer recommendations for the future development of these applications.

Methods

This study followed the PRISMA guidelines to guide the systematic review, the key aspects defined for the analysis are described below.

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Inclusion and exclusion criteria:

- Scope: Articles, research and theses on the development and implementation of mobile applications for rehabilitation.
- Period: 2019-2023.
- Language: English and Spanish.
- Impact: Studies on User Experience and Functional Suitability in mHealth for rehabilitation, excluding the evaluation of clinical effectiveness.
- Areas: Rehabilitation in physiotherapy, occupational therapy and speech therapy.

Information sources

The searches for the studies were carried out in the Google Scholar, PubMed databases and the digital libraries of the Universidad Distrital Francisco José de Caldas and the Universidad de los Andes in Colombia.

Search Strategy

Table 1 shows the decomposition of the research question, identifying keywords for the search for relevant studies.

Table 1. Search strategies.

Do mobile applications	for rehabilitation in physiotherapy, occupational therapy and speech therapy	Comply with ISO/IEC 25010 quality standards in User Experience and Functional Suitability?
Mobile applications, mobile application, apps, app, smartphone, mhealth	Telerehabilitation, teletherapy, rehabilitation, physiotherapy, occupational therapy, speech therapy, logopedics	Functionality Usability User experience Ease of use User satisfaction Software quality Functional requirements Features Specifications

Source: own elaboration.

Based on these words, the following search equation was structured: (teletherapy OR rehabilitation OR telerehabilitation OR physiotherapy OR "occupational therapy" OR "speech therapy" OR logopedics) AND ((smartphone OR "mobile applications" OR "mobile application" OR mHealth OR apps OR app) AND (functionality OR usability OR "user experience" OR "ease of use" OR "user satisfaction" OR "software quality" OR features OR specifications OR requirements))

Data collection process

The search equations and their variations were entered into the platforms of the information sources. The results pages were debugged using a web tracking software[10] to generate a list of documents that were exported to the Rayyan tool.[11]

Study selection

The selection of articles was performed in a semi-supervised two-stage process. In the automated stage, the Rayyan tool was used to identify duplicate studies. Based on this, a group of three researchers carried out a cross-debugging process to eliminate studies that had a similarity threshold greater than 80%. The second stage considered the inclusion and exclusion criteria to discard non-relevant studies, documenting the reasons for these exclusions. In situations of disagreement, it was sought a direct consensus among the researchers in order to ensure a unanimous decision. Finally, it was created a file in CSV (Comma-separated Values) format with the essential data of the studies selected for the research. This file was shared to the team through a spreadsheet in Google

Drive, enriched with extra columns to analyze and evaluate the User Experience and functional suitability characteristics of the mobile applications described in each study. The articles were randomly distributed among the researchers for detailed and collaborative review.

Data List

The data from each study were categorized into three groups:

- Basic: Data including title, abstract, publication date, authors, language, number of pages, journal, publisher, keywords, and country.
- Quality: Indicators related to the evaluation of the quality characteristics of the methodology used by the researchers.
- Analysis: Indicators related to the evaluation of the subcharacteristics of User Experience and functional suitability according to the ISO/IEC 25010 standard.

Evaluation of the quality of the studies

Checklists from two evaluation frameworks were used to analyze the methodological quality of the included studies: CASP (Critical Appraisal Checklists)[8] and MMAT (Mixed Methods Appraisal Tool).[9] CASP was applied to qualitative studies, cases, systematic reviews and randomized controlled trials, while MMAT was used for mixed methods, descriptive quantitative and non-randomized studies. The studies that scored more than 7 points on CASP and more than 3 on MMAT were considered of acceptable quality. The research team conducted a collaborative review, using researcher triangulation to assess the methodological quality based on the content of the studies and checklists.

Mixed qualitative/quantitative evaluation of the studies

A mixed approach that integrated qualitative and quantitative assessments of the sub-characteristics of User Experience and Functional Suitability was used to assess the conformity of mobile rehabilitation applications with the ISO 25010 standard. The identification of strengths and areas of improvement in the rehabilitation mHealths referenced in the studies, allows to quantify the level of compliance: "Compliant", when improvements are not required; "Partially compliant", suggesting the need for adjustments; and "Does not comply", indicating a complete absence of conformity with the evaluated attributes. Methodological triangulation was used to combine qualitative and quantitative analyses, reducing biases. The management and analysis of the studies were carried out efficiently using spreadsheets in Drive and the Rayyan software.

Results

Identification and selection of relevant studies

As shown in Figure 1, of the 138 studies initially identified in the databases, 34 were discarded due to duplicity, leaving a total of 102. After applying the inclusion and exclusion criteria, 21 studies were selected.

The research reviewed comes from a wide geographic range, including Canada, England, the United States, Switzerland, Australia, and the Netherlands, and is focused on the rehabilitation of neurological, musculoskeletal, cardiovascular, and respiratory pathologies. This research highlights the use of "mobile applications" as innovative technologies in mHealth, underlining the importance of User Experience and functional suitability in these digital solutions.

Evaluation of compliance of user experience and functional suitability

Below is described the mixed qualitative and quantitative evaluation obtained for each of the subcharacteristics of "User Experience" and "Functional Suitability" of the mobile applications analyzed with the relevant studies with high methodological quality.

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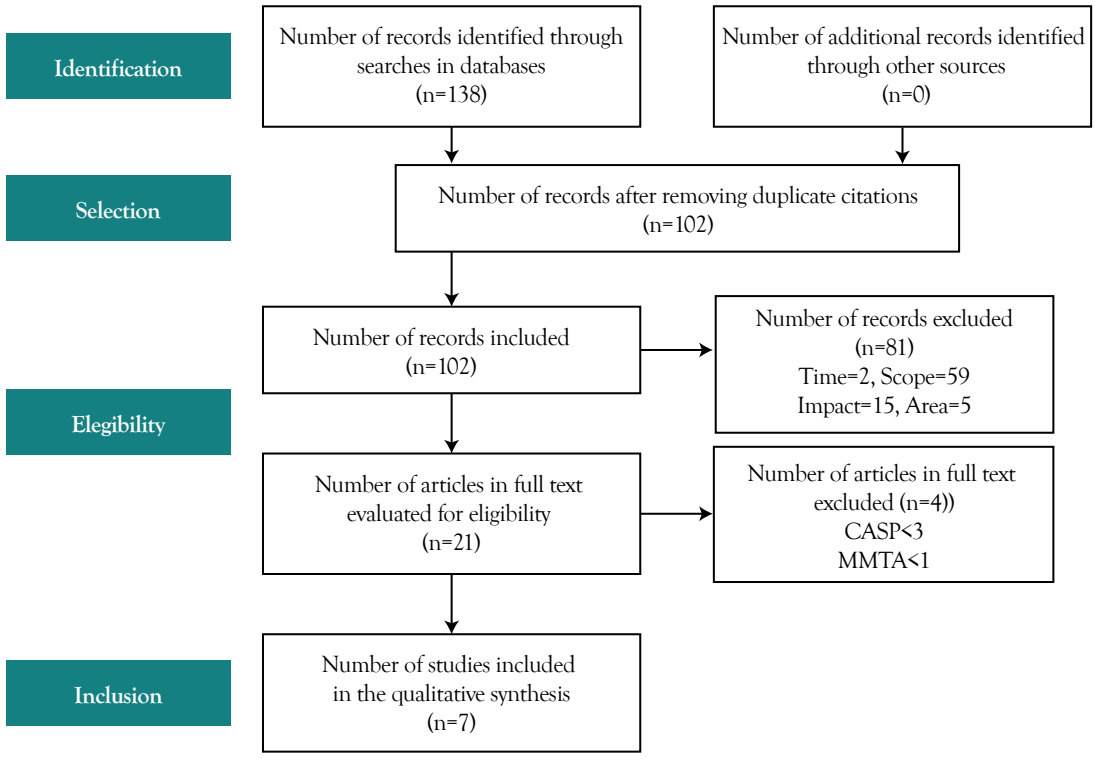

Figure 1. Diagram of the results of the Systematic Review.
Source: Elaboration based on The PRISMA 2020.

Evaluation of the Methodological Quality of the relevant studies

As shown in Figure 1, the number of relevant studies was reduced from 21 to 17 after the evaluation of methodological quality. Of the 21 studies, 8 were evaluated using the MMAT method, obtaining an average grade of 4.25 out of 5; one of these studies was excluded because it did not meet the necessary criteria. On the other hand, 13 studies were evaluated using the CASP method, of which three were discarded for not meeting the established quality standards, resulting in an average rating of 7 out of 10 for the studies that passed this evaluation.

Functional suitability

Capability of the software to meet the specific needs of users.[7] This includes the sub-characteristics of:

- Functional completeness: The software covers all the tasks and objectives defined by the user.
- Correct functionality: the software delivers accurate and correct results.
- Relevant functionality: The software offers features suitable for the user needs,

The strengths and opportunities for improvement found were:

- Functional Completeness

The studies evaluated indicate that rehabilitation applications offer structured programs that meet the needs of users, establishing clear objectives that match the expectations of users, health professionals and caregivers, evidencing their relevance in the field of rehabilitation.[12-15] To improve them, it is recommended to enhance the feedback and communication functions through voice or video messages, expand the range of functionalities to cover more rehabilitation needs and disorders, and encourage more detailed customization to adapt to a broader range of possible requirements.[12-17]

- Correct Functionality

An outstanding strength in studies on rehabilitation applications is the use of artificial intelligence to provide personalized services,

evidencing technological innovation in the field of rehabilitation.[13,15,18] However, areas for improvement are identified, such as the need to constantly update the algorithms[13,19] and improve communications management to respond in a timely manner to queries from patients and professionals, mitigating the frustration due to the lack of responses.[20]

- Relevant Functionality

The studies reveal that rehabilitation applications meet specific needs, offering functions suitable for conditions such as aphasia, rheumatoid arthritis, breast cancer, and low vision, among others.[14,18,21,22] Even so, there is a need for improvement by incorporating mechanisms that collect feedback from users to adjust the functionalities according to the needs[13,14,18,19] and increase the personalization and adaptability of the applications to enhance the effectiveness of the treatment.[15,16]

According to the above results, the level of compliance of the subcharacteristics of functional suitability is presented in Table 2.

Table 2. Evaluation of the subcharacteristics of functional suitability.

Subcharacteristic	Compliance	Percentage
Functional completeness	Compliant	41%
	Partially compliant	59%
Correct functionality	Compliant	65%
	Partially compliant	35%
Relevant functionality	Compliant	65%
	Partially compliant	35%

Source: own elaboration.

Based on the performance of the subcharacteristics of functional suitability, this characteristic has 56.9% of full compliance and 43.1% of partial compliance.

User Experience Feature

Capability of the software product for the user to interact through its interface exchanging information to complete certain tasks7 that covers the following subcharacteristics:

- Recognition of usefulness: The system must have the capability to be understood and adapted to the needs of the user.
- Ease of learning: The system provides the necessary tools for quick and effective learning of its use.
- Ease of operation: The system allows for simple and controlled handling of the software.
- Protection against user errors: Capability to manage unexpected behavior of the users.
- Aesthetics: The system offers a pleasant and user-friendly interface.
- Accessibility: Capable to adapt to various characteristics and disabilities of the users.

The strengths and opportunities for improvement found were:

- Recognition of usefulness

The studies highlight the personalization of mobile applications and direct interaction with health professionals, such as the 3DFysio application, making it easier for users to recognize the usefulness of these applications for their needs.[21] The intuitive design and personalized feedback also help users understand the relevance of the applications in their rehabilitation.[13,15,23].Nevertheless, there are areas for improvement, like the incorporation of more features and educational materials, such as video tutorials or manuals that clarify the capabilities of the software and how they can meet specific user needs.[19,24]

- Ease of learning

The rehabilitation applications stand out for intuitive interfaces that simplify the use and encourage learning.[12,15,25] However, opportunities for improvement such as the need to create educational materials for users who are less familiar with technology and to implement interactive tutorials that enrich the learning experience were detected.[13,14,19,] In addition, it is recommended to clarify the instructions and improve their clarity and navigation within the applications to further facilitate learning and the User Experience.[23,26-28]

- Ease of operation

Studies highlight that rehabilitation applications offer simple operation due to their intuitive and

accessible design, facilitating a fluent user experience for all users, including those with physical or technological limitations.[13,16-18,21,22,25,26] Despite these advantages, opportunities for improvement are identified, such as strengthening the User Experience for people with disabilities through adaptive tools, creating more training materials, simplifying interfaces and improving navigation,[23,26,28] in addition to customizing the experience to increase efficiency and user satisfaction.[22,24,25]

- Protection against user errors

The rehabilitation applications analyzed are characterized by their intuitive design and customized functionalities that reduce errors.[12,13,25,26,28] To further improve them, it is recommended to increase accessibility for different disabilities, implement robust data validations to prevent errors, offer training and understandable documentation for correct use of the system,[14,17,20] and add "undo" and "redo" options that allow users to quickly correct errors without losing important information.[27]

- Aesthetics

Rehabilitation applications integrate cultural and aesthetic considerations, featuring clear interfaces and pleasing designs that fuse functionality with visual appeal.[18] The use of virtual reality to create immersive environments significantly improves the user experience.[25] For improvement, it is suggested to increase consistency in interface design, such as styles of buttons and fonts, and to offer interface customization, allowing users to adjust color themes or display modes.[13,16,19,20,24,28]

- Accessibility

The mobile applications reviewed cover a wide range of pathologies, demonstrating their versatility in addressing diverse user needs, from aphasia and cancer to respiratory failure and sequelae of strokes.[13,15,18,25] They stand out for their inclusive designs, suitable for people with visual, hearing, motor and cognitive disabilities.[19,22] Despite these strengths, there are areas to improve accessibility, such as the integration of voice recognition and screen reader functionalities, engaging users with disabilities in testing to identify and eliminate User Experience barriers,[12,21,26] and offering options for customization of the interface that meet the specific needs of each user, thus improving accessibility and User Experience.[14,19]

According to the above results, the level of compliance of the sub-characteristics of the user experience is presented in Table 3.

Table 3. Evaluation of User Experience subcharacteristics.

Subcharacteristic	Compliance	Percentage
Recognition of usefulness	Compliant	76%
	Partially compliant	18%
	Does not comply	6%
Ease of learning	Compliant	41%
	Partially compliant	53%
	Does not comply	6%
Ease of operation	Compliant	29%
	Partially compliant	59%
	Does not comply	6%
Protection against user errors	Compliant	29%
	Partially compliant	24%
	Does not comply	53%
Aesthetics	Compliant	35%
	Partially compliant	18%
	Does not comply	47%
Accessibility	Compliant	18%
	Partially compliant	65%
	Does not comply	18%

Source: own elaboration.

Based on the performance of its subcharacteristics, the user experience has 56.9% of full compliance and 43.1% partial compliance.

Discussion

The results of this systematic review highlight important aspects of the quality of mobile applications for rehabilitation in terms of User Experience (UX) and Functional Suitability, according to the ISO/IEC 25010 standard. Although some applications show acceptable compliance, key areas that require substantial improvements are identified.

One of the most important contributions of this study is the identification of the opportunities for improvement in the User Experience with these

applications. Only 38.2% of applications fully meet UX criteria, which is concerning given that ease of use and user satisfaction are essential for adherence to therapies. This finding is consistent with previous studies that highlight UX problems in healthcare apps, where complicated interfaces and lack of customization contribute to abandonment by the patients.

Regarding Functional Suitability, 56.9% of the applications meet the criteria of the standard, indicating that more than half meet the basic needs of users. This finding coincides with previous studies, pointing out that many applications comply with the basic functionalities, but lack advanced features that allow personalization of the treatment.

Although emerging technologies such as artificial intelligence have improved some aspects of these applications, shortcomings in intuitive interfaces persist, limiting their adoption.

This study has some limitations, such as its temporal focus on studies between 2019 and 2023, and the evaluation methodology based on the CASP and MMAT frameworks, which although robust, might not capture all the subtleties of the studies reviewed.

Despite these limitations, the study offers valuable implications for the design and development of rehabilitation mHealth. It is recommended to prioritize simplification and customization of interfaces, as well as to improve the communication between patients and healthcare professionals to better meet individual needs and increase adherence and health outcomes.

Although mobile applications for rehabilitation have great potential, it is crucial to improve UX and Functional Suitability to ensure that they fully fulfill their promise of improving the rehabilitation and quality of life of the patients. Collaboration between developers, researchers and healthcare professionals is essential to create technically competent, user-centered, accessible and customizable applications.

Conclusions

The studies indicate that mobile rehabilitation applications have an acceptable level of User Experience and functional suitability, but with a margin for improvement. It is recommended to create simpler and more intuitive interfaces, add educational content, and improve personalization and accessibility. It is also suggested to improve communication between patients and health professionals, expand functionalities to cover more conditions, and regularly update the algorithms to increase the accuracy and effectiveness of treatments.

Authors' contribution

All authors contributed to the co-construction, evaluation, revision, adjustments and validation throughout the entire process of preparation of the article. Each one has performed one or more activities according to the stage of design of the article.

Ethical considerations

Study without risk according to the research standards established by the World Health Organization and the current Helsinki Law.

Conflicts of interest

None declared by the authors.

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