

Telerehabilitation Platforms in Times of COVID-19: Usability Evaluation

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ABSTRACT

The health response to the COVID-19 pandemic has significantly impacted neurorehabilitation provision worldwide. Telerehabilitation (TR) or e-rehabilitation refers to the delivery of rehabilitation via information and communication technologies (ICT) used to directly provide remote physiotherapy activities, including “evaluation, assessment, monitoring, prevention, intervention, supervision, education, consultation, and coaching”. As part of the precautions established in response to the COVID-19 pandemic, TR is a procedure that allows continuity of care for patients who can benefit from remote sessions while ensuring greater protection for those who are members of vulnerable groups. In this paper, we propose to apply the Human-Computer Interaction field’s concept of “usability” to the evaluation of three TR platforms, using a usability evaluation process proposed by Rautela A. and a method of inquiry by Lewis, such as the CSUQ (Computer System Usability Questionnaire) applied by IBM, to compare the results with the SUS (Systems Usability Scale) which allows verifying its acceptability ranges by the final users categorized as “acceptable” above 70, “marginal” between 50 and 70 and “unacceptable” below 50. The findings have allowed us to obtain recommendations and identify useful functionalities that could apply in designing and developing a TR platform to treat the SARS-COV-2 virus related complications.

Keywords: Telerehabilitation, Usability evaluation, SARS-COV-2, Telemedicine, E-rehabilitation, COVID-19, CSUQ

INTRODUCTION

Following the pandemic caused by the SARS-COV-2 virus, TR has become a tool to provide health services safely. TR has positioned itself as an innovative health strategy that seeks to improve access to health by applying advances in ICT (Brennan, Mawson and Brownsell, 2009). The rise of TR, an emerging field of telehealth, brings new challenges, mainly related to supporting the psychiatrist in planning, monitoring, and evaluating rehabilitation. Currently, it is common for patients who have demonstrated health-improved following hospitalization caused by the SARS-COV-2 virus to be sent home. However, many of these patients may have consequences of prolonged hospitalization and isolation, such as physical (fatigue, weakness), cognitive (delirium), and emotional complications (depression) (Stam, Stucki and Bickenbach, 2020).

Research conducted in (Tousignant *et al.*, 2006) and (Bettger *et al.*, 2020) has demonstrated the effectiveness of TR for physical and mental problems improving patient's quality of life by overcoming obstacles such as the distance to the institution providing care, the strain associated with these face-to-face rehabilitation appointments on family members, and the lack of homecare for rehabilitation.

Using software within TR programs supports professionals aiding the construction of a rehabilitation program and as a source of learning and knowledge (Cardoso, 2021). For the design and development of technologies that improve TR is important to consider usability, a key aspect that facilitates the use of the product relating to the ability to learn, efficiency, error reduction, and satisfaction. The correct incorporation of usability must consider principles, metrics, and patterns that facilitate effectiveness, quality, and service usefulness. Lack of usability and a user-centered approach can lead to problems such as confusion, repetitive errors, or even abandonment of the TR program (Henry Pilco *et al.*, 2019).

This work aims to analyze the usability evaluations of TR web platforms, considering efficiency, effectiveness, and satisfaction with the CSUQ. This questionnaire will allow us to get data regarding the platform's usability, the quality of the information presented, and the quality of the interfaces.

The usability evaluation results will help us consider web platform design and development features for the TR of physical and cognitive disorders. Consequently, we encourage health professionals to adapt their job to TR, improving patients' autonomy and quality of life.

This paper is structured as follows: section 2 presents the related work in the context of TR and usability. Section 3 describes the case study applied in this work. Section 4 proposes the usability evaluation along with the experimental process developed. Finally, section 5 and 6 present the results and conclusions, respectively.

MATERIAL AND METHODS

TR, an emerging field of telehealth, refers to providing synchronous or asynchronous rehabilitation treatment via ICT, minimizing barriers caused by distance, time, and costs (Brennan *et al.*, 2010).

Several authors have conducted usability evaluations of TR programs to treat sequelae caused by the SARS-COV-2 virus; in these investigations were

used communication tools such as Zoom™, Viber™, or Google Meet™ for TR sessions. Research presented in (Finkelstein *et al.*, 2020) and (Lee *et al.*, 2023) affirms the high potential for patient-centered digital health and a high acceptance of the rehabilitation program. However, in (Valera *et al.*, 2022), the potential of TR is overshadowed by existing technical problems, mostly due to internet connection in a developing country.

Previous studies exist and contribute to the enhancing and enrichment of the telerehabilitation research. A systematic literature review was conducted in (Valverde-Martínez *et al.*, 2023) demonstrating that the use of TR could be an effective tool for the treatment of persistent symptoms after suffering from COVID-19. No records have been found of research conducted for the treatment of the sequelae of the SARS-COV-2 virus using TR platforms.

On the other hand, the authors of (Solorzano *et al.*, 2021) and (Pérez-Medina *et al.*, 2020) performed usability evaluations on a TR platform for patients recovering after hip replacement surgery. The results obtained in those investigations have provided the researcher's important suggestions to improve the platform's current features. In addition, (Henry Pilco *et al.*, 2019) demonstrates the necessity of performing usability evaluations throughout the software development cycle, resulting in improvements in the system's usability, even before writing the first code lines.

The sample selected for a usability evaluation is a widely discussed topic because if conducted with many users, the costs tend to outweigh the benefits, while too small a sample may miss usability issues. The study presented in (Faulkner, 2003) shows that up to 80% of usability problems can be found using a sample of five participants. Therefore, the findings of this research imply that more participants are unnecessary.

Case Study

Telerehabilitation platforms allow the rehabilitation process to be carried out in different ways. TR sessions can be carried out using any of the three modes of communication: Synchronous: delivered to the patient through video calls or virtual meetings. Asynchronous: by sending text messages, emails, audio, or videos with multimedia material. Hybrid: by incorporating the two modes.

For the development of this research were selected three web platforms for TR. The platforms were evaluated considering the following criteria:

One or more modes of communication to carry out the TR sessions.

Potential for physical or cognitive TR, the platform should include a set of exercises for physical or cognitive rehabilitation from the sequelae of the SARS-COV-2.

Preferably with free access or a free trial period to access the resource for a free evaluation.

The selected platforms were as follows:

- Rehab Guru (<https://www.rehabguru.com/>)
- Rehab My Patient (<https://www.rehabmypatient.com>)
- FreePT (<https://securelogin.freept.com/FreePt/login.do>)

The work process is as follows:

The physiatrist personality evaluates a patient's initial condition. After analyzing the evaluation results, a rehabilitation program is designed. The

patient is instructed to complete the rehabilitation program using a web-based platform at home. Once the patient has conducted all the TR sessions will be able to inform the physiatrist of any program-related difficulties. In the event of finding ailments or difficulties, the physiatrist will advise the patient again, accompanying the patient throughout the rehabilitation process. If no rehabilitation-related issues are identified, the physiatrist will conduct periodic examinations to monitor the patient's improvement.

The selected platforms allowed the study to be carried out from two perspectives:

Physiatrist Perspective

The web-based platform allows physiatrists to create an account to manage their patient's TR sessions and therapy plans. Figure 1 depicts the three platforms that permit patient registration: (a) Rehab Guru (Rehab Guru, 2022), (b) Rehab My Patient (RehabMyPatient, 2023), and (c) FreePT (FreePT, 2023). In addition, Figure 2 evidence the creation of a template for rehabilitating a specific ailment, in this case, to treat the sequelae of the SARS-COV-2 virus, as outlined for Rehab Guru (a) and Rehab My Patient (b). The FreePT platform does not include these workouts; the exercise programs are designed and sent by email, as seen in (c).

Finally, communication with the patient can be seen in Figure 3, where an appointment for rehabilitation is scheduled; at the appropriate time, the physiatrist will advise the patient on how to execute and supervise the completion of the exercises through videoconference. Rehab Guru (a) and Rehab My Patient (b) platforms simplify the task of creating TR sessions as they automatically generate a link for a video call, even though this functionality is platform specific for Rehab My Patient. In contrast, the FreePT (c) platform makes the task more complicated by requiring the physiatrist to schedule a meeting for the rehabilitation session and email it to the patient.

Figure 1 displays three screenshots of patient registration forms:

- (a) Registration with e-mail – Rehab Guru:** A form titled "Add Client" with fields for "Client name" (Bruno Aguirre) and "Email" (brunoochoa@gmail.com), and an "Add" button.
- (b) Registration with patient name – Rehab My Patient:** A form titled "Add New Patient" with fields for "First Name *" (Bruno), "Last Name *" (Aguirre), "Email" (brunoochoa@gmail.com), and "Address".
- (c) Registration with patient clinical information – FreePT:** A form with a profile picture of a man, a "Case" section, and a "Contact Information" section. The "Case" section includes fields for "Last *", "First *", "DOB *", "Sex *", "Address:", "Zip:", "City:", and "State:". The "Contact Information" section includes fields for "Home Phone:", "Work Phone:", "Ext:", and "Email:". There is also an "Active" checkbox.

Figure 1: Comparison of patient registration (own figure based on (a), (b), (c)).

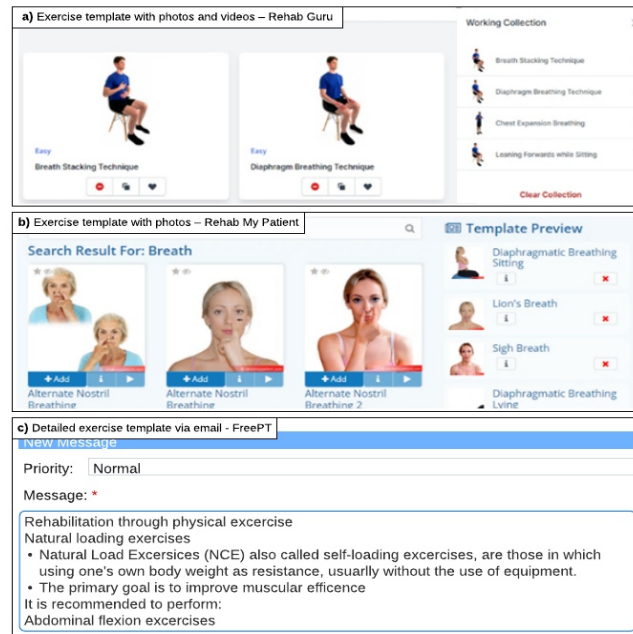


Figure 2: Comparison of the creation of an exercise template (own figure based on (a), (b), (c)).

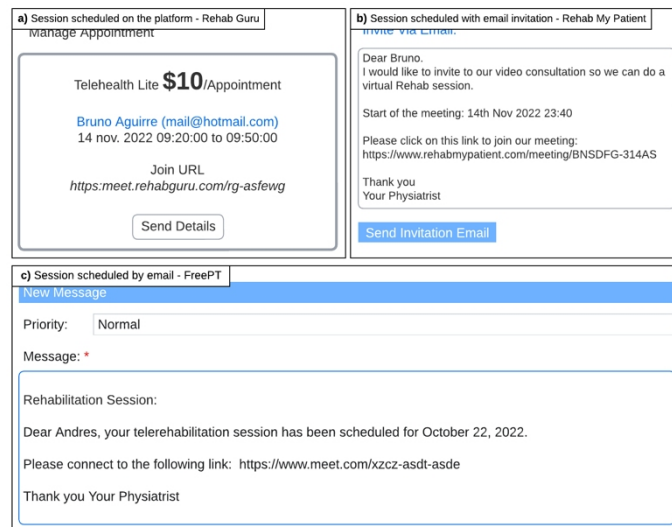


Figure 3: Comparison of a TR session (own figure based on (a), (b), (c)).

Patient Perspective

Patients can review the potential rehabilitation programs proposed by their physiatrists. These programs will be communicated using one or more communication modes, simplifying the patient's tasks. Figure 4 shows the email notifications sent to patients upon completion of therapies; the Rehab Guru (a), Rehab My Patient (b), and FreePT (c) platforms also provide the attachment of photographs and videos of the rehabilitation program.

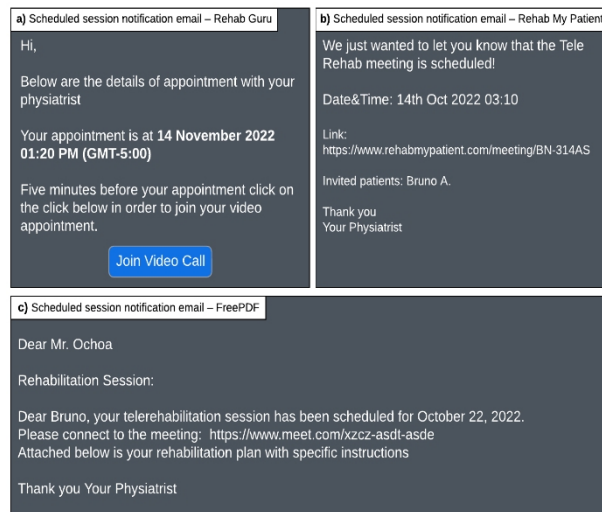


Figure 4: Comparison of TR sessions notifications.

EVALUATION RESULTS AND DISCUSSION

This section summarizes the process corresponding to the usability evaluation performed on the TR web platforms. The usability evaluation was carried out considering the protocol proposed by Abhay Rautela (Rautela, 2018) (see Figure 5). This protocol was accompanied by a Lewis inquiry method, such as the CSUQ.

Participants

The process was carried out with a group of five users since, as mentioned previously, Laura Faulkner demonstrated in (Faulkner, 2003) that, despite evaluating with just five users, the results of usability problems encountered represent between 55% and 85% of the total.

Materials and Methods

The following materials were considered for this usability evaluation:

- Web-based telerehabilitation platforms
- Usability Evaluation Protocol
- CSUQ

The CSUQ consists of sixteen questions using the empirically validated 7 point Likert scale, distributed in 4 categories: System Utility (CSUQ1 to CSUQ6). Information Quality (CSUQ07 to CSUQ12). Interface Quality (CSUQ13 to CSUQ15). General (CSUQ16).

Tasks and Procedure

The user tasks (T) completed by a physiatrist and a TR patient are shown in Tables 1 and 2, respectively.

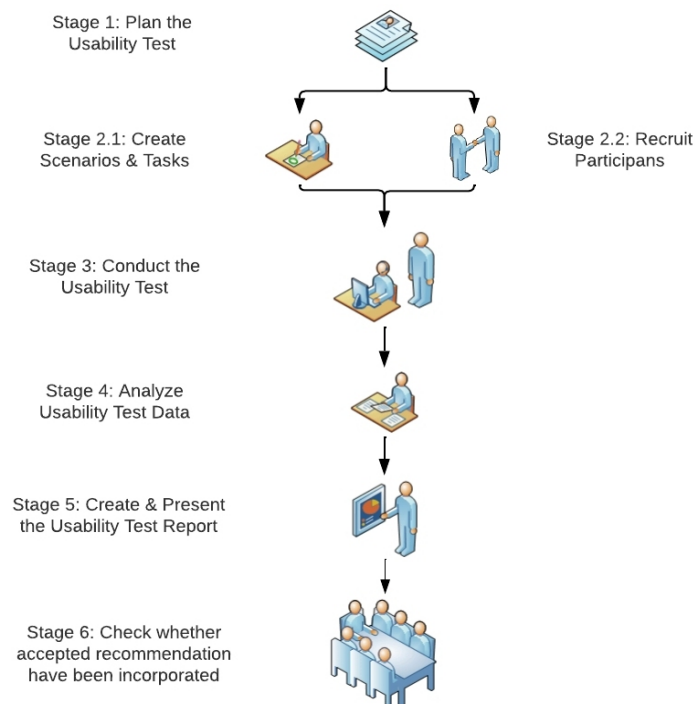


Figure 5: Usability Evaluation Protocol.

Table 1. Activities performed in the role of a physiatrist.

Tasks and subtasks	
T1. Login to the Platform	1. Enter your e-mail address. 2. Enter the password. 3. Click the “Log In” button.
T2. Register a Patient	1. Click the “Clients” or “Add New Patient” button. 2. Enter patient data. 3. Click the “Add New Patient” button.
T3. Create a telerehabilitation session	1. Click the “Clients” or “Add New Patient” button. 2. Enter patient data. 3. Click the “Add New Patient” button.
T4. Logout from the platform	1. Click the “Log out” button in the upper right corner of the platform

Table 2. Activities performed in the role of patient.

Tasks and subtasks	
T1. Entering a telerehabilitation session	1. Login to your email. 2. Search for the e-mail with your appointment schedule. 3. Open the e-mail with your appointment schedule. 4. Click on the URL link with the appointment meeting or rehabilitation program attached.

The participants performed the proposed tasks and then completed the CSUQ, with data collected to determine the outcomes.

DISCUSSION

For the analysis of the results were reviewed the values obtained in the usability surveys were, these values ranged from 1(Strongly agree) to 7(Strongly disagree) and included the option “Not Applicable” (N/A); the lower values were interpreted as indicators of a higher degree of satisfaction. The authors have decided to hide the names of the platforms to avoid affecting the platforms analyzed. In addition, some correspondence was made between the CSUQ and SUS values to transform the values between 1 to 7 of the CSUQ scale to a 0 to 100 point scale that matches SUS for interpretation. The equation for this transformation was presented in 1:

$$CSUQ = 100 - \left(\left(\left(\frac{\sum_{n=1}^{16} CSUQ_n}{16} \right) - 1 \right) * \left(\frac{100}{6} \right) \right) \quad (1)$$

Breaking this down, the process of getting from a CSUQ score to one that matches the SUS involves subtracting 1 from the mean of the 16 individual CSUQ items and multiplying that by 100/6 to stretch it out to a 0 to 100 point scale, then subtracting from 100 to reverse the scale (Lewis, 2018).

The results obtained after this transformation are presented in Figure 6, where the equivalent score on the SUS can be seen for each question in the questionnaire and each web platform analyzed. This graph shows a clear superiority in the usability of the Platform 1, followed by Platform 2 and Platform 3.

The transformation was performed to employ the Bangor scale, presented in Figure 6, which allows us to compare adjective ratings and acceptability scores about the SUS score obtained. As we can see in the Bangor scale (Bangor, Kortum and Miller, 2009), the value “Acceptable” is assigned when the evaluation score is above 70, “Not Acceptable” when the value is below 50, and “Marginal” when it is between 50 and 70.

Concerning the categories of usability evaluation, Figure 7 shows the percentages obtained by each evaluated platform. As can be seen, Platform 1 once again stands out above the other platforms in areas such as the system’s usefulness and the interface’s quality; however, in aspects such as the quality of the information, it shares a high score with Platform 2. See Figure 8.

Generally, the rating of the two web platforms for TR (Platform 1 and Platform 2) following the equivalence presented in the Bangor scale is “Acceptable”, as they present 89.69% and 73.75%, respectively. However, the

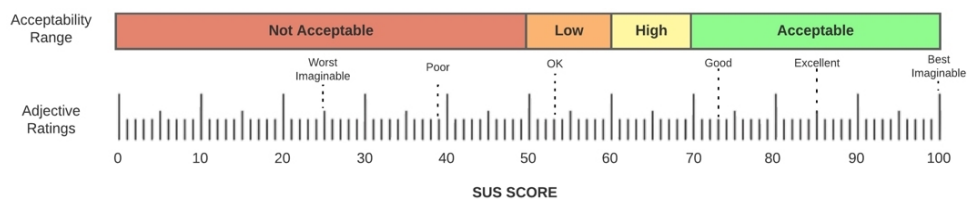


Figure 6: Bangor SUS scale.

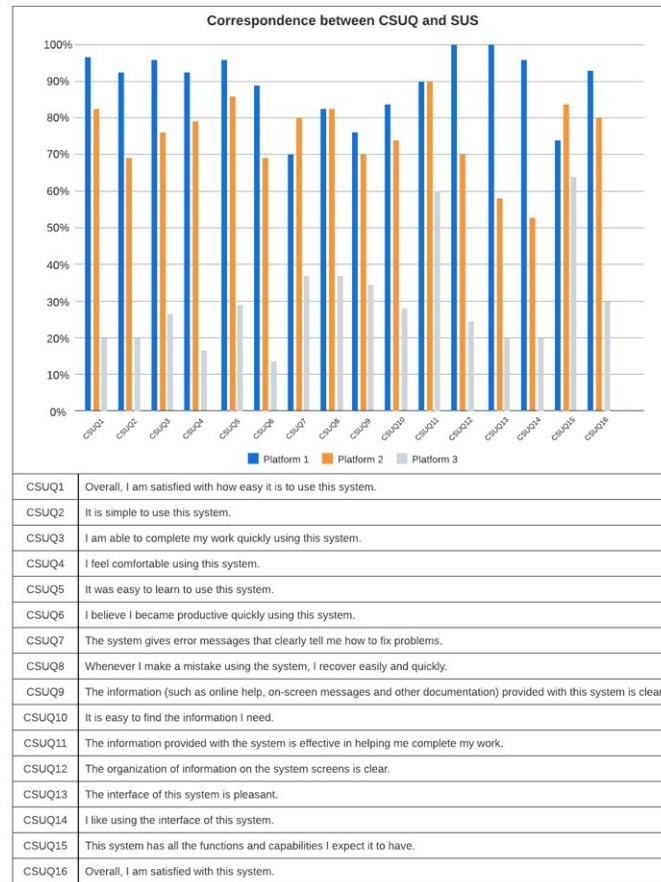


Figure 7: Percentage by category.

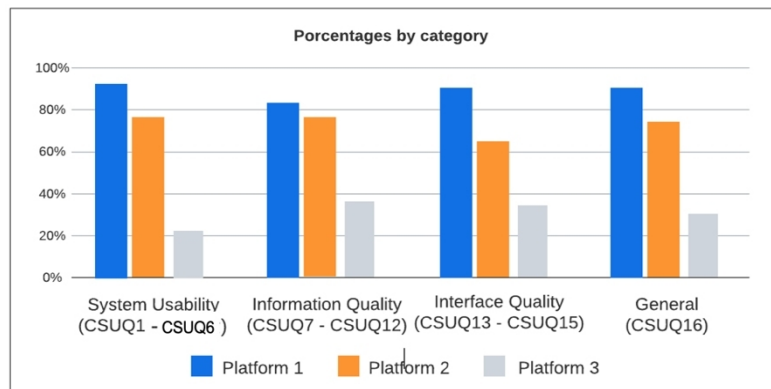


Figure 8: Percentage by category.

Platform 3 shows clear deficiencies in all the aspects evaluated since it presents an average of 30.52% in the usability evaluation, equivalent to “Not Acceptable” (see Figure 7).

CONCLUSION

The present work evaluated the usability of 3 web platforms for TR following the protocol proposed by Abhay Rautela and the incorporation of the CSUQ; this process allowed us to identify design elements for the development of future TR platforms.

The benefits that TR platforms offer to the community allow adults, youth, and children to access physical and mental rehabilitation from the comfort of their homes. However, it is essential to analyze the patient's needs for treatment, hence the importance of conducting studies that provide feedback tools that meet the satisfaction conditions of end users, indicating to which treatment they have been oriented.

The results obtained provide us with important findings on the usability to be incorporated into a web platform for TR, with the aim that experts in the field of health adapt their work to a rehabilitation modality, allowing to improve the autonomy and quality of life of their patients, minimizing the barriers caused by distance, time, and costs.

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