ORIGINAL ARTICLES

The long-term user experience of an m-Health application

A experiência do usuário a longo prazo de um aplicativo m-Health

La experiencia a largo plazo del usuario de una aplicación m-Health

Jakeline Karla Locatelli[1,a]
jake_linelocatelli@hotmail.com | https://orcid.org/0000-0003-2675-3740

Silvana Alba Scortegagna[1,b]
silvanalba@upf.br| https://orcid.org/0000-0002-5100-6459

Ana Carolina Bertoletti De Marchi[1,c]
carolina@upf.br | https://orcid.org/0000-0002-7704-3119

[1] The University of Passo Fundo, Health Institute. Passo Fundo, RS, Brazil.

[a] Master of Human Ageing from the University of Passo Fundo.
[b] Doctoral degree in Psychology from the University of São Francisco.
[c] Doctoral degree in Informatics in Education from the Federal University of Rio Grande do Sul.

ABSTRACT

Low user engagement in m-Health applications has been driving the use of retention techniques that aim to ensure a satisfactory long-term user experience. The aim was to understand the experience of hypertensive patients interacting with a mobile health application for 12 months. A qualitative/exploratory study was conducted after 12 months, with the same experimental group of participants as the non-randomized controlled clinical trial conducted in 2019. The mean age of the 16 participants was 57 years (SD=8), of which11 were female. All had low socioeconomic and educational levels. Content analysis showed no engagement with the m-health app over time. The main factors contributing to the lack of engagement were; inability of the user to use the app, lack of support and technical problems. When designing m-Health interventions, it is important to understand users' behavioral characteristics, motivations for treatment, level of involvement in health care, and ability to use technology.

Keywords: Digital health; Self-care; User experience; m-Health; Engagement.

RESUMO

O baixo envolvimento dos usuários em aplicativos m-Health vem impulsionando o uso de técnicas de retenção que visam garantir uma experiência do usuário (UX) satisfatória a longo prazo. Objetivou-se compreender a experiência de pacientes hipertensos interagindo com um aplicativo de saúde móvel (m-Health) durante 12 meses. Realizou-se estudo qualitativo/exploratório após 12 meses, com o mesmo grupo experimental de participantes do ensaio-clínico controlado e não-randomizado realizado em 2019. A idade média dos 16 participantes foi de 57 anos (DP=8); 11 eram do sexo feminino, com baixos níveis socioeconômicos e educacionais. A análise de conteúdo não mostrou nenhum envolvimento ao

longo do tempo usando o aplicativo m-Health. Os principais fatores que contribuíram para a falta de envolvimento foram: incapacidade do usuário de usar o aplicativo, falta de suporte e problemas técnicos. Ao propor intervenções que utilizem m-Health, é essencial conhecer características comportamentais dos usuários, motivações para o tratamento, nível de envolvimento nos cuidados com a saúde e sua capacidade de usar tecnologias.

Palavras-chave: Saúde digital; Autocuidado; Experiência do usuário; m-Health; Engajamento.

RESUMEN

La baja participación de los usuarios en las aplicaciones de m-Health ha impulsado el uso de técnicas de retención que tienen como objetivo garantizar una experiencia de usuario satisfactoria a largo plazo. Se pretendió comprender la experiencia de pacientes hipertensos interactuando con una aplicación de salud móvil durante 12 meses. Se realizó un estudio cualitativo/exploratorio después de 12 meses, utilizando los participantes del ensayo clínico controlado no aleatorizado que se llevó a cabo en 2019. La edad media de los 16 participantes fue 57 años (SD=8); 11 mujeres, con niveles socioeconómicos y educativos bajos. El análisis de contenido no mostró compromiso a lo largo del tiempo utilizando la aplicación m-Health. Los principales factores contribuyentes fueron: incapacidad del usuario para utilizar la aplicación, falta de apoyo y problemas técnicos. Cuando se proponen intervenciones con m-Health, es esencial conocer las características de comportamiento de los usuarios, sus motivaciones para el tratamiento, nivel de implicación en el cuidado de la salud y capacidad para utilizar tecnologías.

Palabras clave: Salud digital; Autocuidado; Experiencia de usuario; m-Health; Compromiso.

INTRODUCTION

A lack of commitment to treatment is a contributing factor to the increase in public health problems (Albini *et al.*, 2016), accentuating these issues as the population ages. Periodic verification of health conditions is essential to obtain favorable and accessible results (De Marchi *et al.*, 2020; Toro-Ramos *et al.*, 2017) and should be encouraged early on to provide strategies that might improve treatment adherence.

The World Health Organization (WHO) defines digital health, or the use of digital technologies for health, as an essential field of practice for employing innovative ways of using Information and Communication Technology (ICT) to improve health conditions (WHO, 2019). Among these technologies are m-Health applications, a general term for the use of mobile phones and other wireless technology in medical care to help monitor patients (Oliveira *et al.*, 2020).

m-Health apps have immense potential to promote self-care for health through remote monitoring (Ashoorkhani *et al.*, 2016; Scotton; Barletta; Neufeld, 2021; Volpi *et al.*, 2021). However, more research should be conducted to propose and evaluate solutions that can truly engage users to keep them using the application over time, not just in the first few weeks of use (Biduski *et al.*, 2020).

Low engagement with m-Health apps has prompted the use of some techniques to attract and retain more users (Rao; Joshi, 2020). Among these techniques are gamification (Cechetti *et al.*, 2019), features representing a behavioral approach to intervention (Park *et al.*, 2019), and self-monitoring of health (Liang *et al.*, 2018).

Given the context of low engagement, it is essential to fully study and comprehend how the user experience (UX) changes over time, especially when interacting with m-Health apps. User experience is a combination of a user's internal state, the characteristics of the designed system, and the context in which interaction occurs (Biduski *et al.*, 2020; Tubin; Mazuco Rodriguez; De Marchi, 2021; Zarour; Alharbi, 2017). In addition, UX is related to the period in which the interaction with the product occurs. In the case of cumulative or long-term UX, evaluation is made after an extended period using the product. This is based on reflections from several episodes of use (Marti; Iacono, 2016).

Investigating how UX evolves when using m-Health apps over time, allows direct actions to improve users' health conditions and the design of innovative interventions using technologies. Therefore, we sought to understand the long-term experience of patients with the use of an m-Health application. This application was developed by Cechetti *et al.* (2019), to engage patients with arterial hypertension in the self-management of their health conditions. A previous study identified that patients' experience when using the same app for three months was satisfactory, and users had a good perception of the app (Volpi *et al.*, 2021). However, there is evidence that many users stop using m-Health apps within the first few weeks of use (Biduski *et al.*, 2020; Kujala *et al.*, 2012; Marti; Iacono, 2016; Shin; Lee; Hwang, 2017).

To meet user needs it is important to evaluate user experience (Guimarães; Dos Santos; Fontana, 2017). This study aimed to understand the long-term experience of hypertensive patients with the m-Health application. Therefore, we investigated the user experience after 12 months of the clinical trial conducted by Volpi *et al.* (2021).

MATERIALS AND METHODS

This research is qualitative and exploratory and was conducted with the same experimental group of participants in the non-randomized, controlled clinical trial conducted in 2019 (Volpi *et al.*, 2021). In addition, the user experience (UX) when using the eLifestyle application was analyzed.

The eLifestyle application developed by Cechetti *et al.* (2019) combines gamification with elements designed to engage patients in self-monitoring of health conditions. As the user enters information, they

score points, progress through levels, obtain results, rankings, and feedback. The app also records variables (or factors) related to hypertension management, such as blood pressure, weight, waist circumference, height, sleep, mood, and involvement in physical activities. Other features include baseline risk assessment, recommendations, alerts, and reminders about medications, physical activity, and measurements. In addition, patient data is stored in the cloud, which allows healthcare professionals access to monitor the patient remotely (Volpi *et al.*, 2021). The Research Ethics Committee of the University of Passo Fundo approved the project under the approval number 3,414,793.

Study population

The study population consisted of 36 participants from the Volpi *et al.* (2021) experimental group. All patients who used the eLifestyle application (registered with the INPI under number BR5120180009735) for three months had hypertension and were registered with the Unified Health System in the north of the state of Rio Grande do Sul, Brazil. Participants were invited to participate in the study through telephone, SMS, or WhatsApp messages. However, participants were excluded after five unsuccessful contact attempts. In the end, 16 of the 36 individuals agreed to participate in the research.

Data Collection

As a data collection instrument, the researcher prepared a semi-structured interview which was reviewed by two professionals (research professors in psychology and medical informatics, who work with user experience and m-Health applications). The questions were extracted and adapted from studies in the literature (Assmann; Zanatta; De Marchi, 2021; Biduski *et al.*, 2020; Tubin; Mazuco Rodriguez; De Marchi, 2021; Vermeeren *et al.*, 2010). We chose to use open-ended questions to capture as much detail as possible, allowing users to express themselves freely.

The interview had four questions: 1. How was your experience using the application? 2. What difficulties did you encounter that made you stop using the application? 3. What advantages did you find that made you use the application? 4. If we were to develop an updated version of the application, what would you like to change? When answering the interview questions, the study participants had the option of selecting previously established standard answers.

Data collection procedure

Participants responded to a telephone interview, conducted during the pandemic by the first author of this article and lasting approximately 20 minutes. On the day of the telephone call, after the interviewee's consent, recording of the conversation began. The recording was performed using voice recorder software on the computer. After the recording, the interviews were transcribed in full. In addition, the Free and Informed Consent Term (FICT) was issued orally and included on the recording.

Data analysis

After transcribing the recorded interviews, the qualitative data were categorized according to Bardin's (2008) guidelines. Finally, the content analysis and its application were organized using a spreadsheet, conducted in three stages: pre-analysis, material exploration, interpretation and analysis of results (Silva; Fossá, 2015). In the pre-analysis, the preliminary ideas were systematized based on skimming through all the material, choosing the documents for analysis, verifying the objectives and hypotheses, and constructing the indicators. Subsequently, the material was explored with coding and categorization, during which

the text registration units were grouped and regrouped. In the final stage, the results were analyzed and interpreted to uncover the meaning of the messages through a reflective and critical analysis.

Two independent analysts created the categories. A third analyst, who has experience of using content analysis to understand the data in qualitative research, performed the validation. Categorical analysis was selected as it is considered the best alternative to address emerging issues related to subjectivity, associated with values, opinions, and attitudes through qualitative data (Palmeira; Cordeiro; Prado, 2020).

RESULTS

Of the 16 participants interviewed, 11 were female, and 5 were male. They had a mean age of 57 ± 8 years, were married or in a stable relationship, with up to 9 years of education, an income of 1 to 3 minimum wages, and with self-reported comorbidity of 1 to 4 diseases. All participants stopped using the application after the end of the intervention period in 2019.

The qualitative analysis of the results started with two independent analysts performing the pre-analysis and exploration of the material, by grouping the answers to each question. The data were made available in an electronic spreadsheet for a third analyst, who verified disagreements and validated the created categories, which are systematized in Table 1.

Table 1 - *Categories defined from the content analysis.*

Question	Category	Participant
How was your experience using the application?	Satisfactory	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15
	Unsatisfactory	P16
What difficulties did you encounter that made you stop using the application?	User inability	P9, P13, P15, P16
	Lack of Engagement	P3, P5, P7
	Lack of Follow-up	P4, P12, P16
	Technical Aspects	P1, P2, P6, P8, P10, P14
What advantages did you find that made you use the application?	Usability	P1, P2, P3, P7, P8, P10, P12, P14, P15
	Features	P4, P5, P6, P10, P11, P12, P13
If we were to develop an updated version of the application, what would you like to change?	New Features	P2, P5, P6, P12
	Improve usability	P8, P9, P11, P13
	Technical Support	P1, P3, P4, P5, P9, P16

Source: developed by the authors.

In question one, participants' responses were categorized into Satisfactory and Unsatisfactory. Fifteen (N=15) of the participants reported having had a satisfactory experience using the app.

"it was good, I really liked it" (P2).

"my experience was good" (P3).

"It is a good thing, I liked it" (P5).

"It helped me a lot" (P6).

"it was very good, I liked it" (P7).

"very good, really great, I loved it" (P8).

For four participants, the satisfactory experience was associated with practicality in using the application, according to the statements:

"very practical" (P1).

"I found it easy to use" (P3).

"I liked it, it was practical, it was not complicated at all" (P10).

"It was very practical, in asking for the day, time, and pressure value, it was really practical" (P14).

Only P16 showed dissatisfaction with the experience of using the application. In their answer, it is possible to perceive difficulty in relation to use of the app and a lack of motivation:

"I will be quite frank with you, I could not adapt, I couldn't, I tried to do it, but I am not doing it, I stopped more than a year ago when they came to CAES and taught me, but I could not…" and *"but my pressure is good, thank God, it is ok now, I have seen it through the apps, it has been good, but the app, I have not used it"* (P16).

In question two, participants' responses were classified into the categories – User Inability, Lack of Engagement, Lack of Follow-up, and Technical Aspects. User Inability is associated with the participants' difficulties in using the technology and was identified in the responses of four users:

"I did not know how to write" (P9).

"I do not know how to deal with this application" (P13).

"oh, it was at the beginning, I didn't, I could not access it" (P15).

"I could not use it" (P16).

"I am almost 60 years old, I am literate, but I have difficulty using the app" (P9).

The Lack of Engagement category expresses non-adherence to the use of the app in the long term. None of the interviewed participants used the application after the intervention period conducted in 2019. Among the statements that point to a lack of engagement, the following stand out:

"due to forgetfulness" (P3).

"slackness, I stopped, I left" (P5).

"enough is enough. At night I go to sleep tired, then I ended up forgetting" (P7).

The Lack of a Follow-up category shows how there is a clear need for qualified professionals to teach and assist in the ongoing use of the application. Participants report:

"look, I just was not contacted anymore" (P4).

"difficulty was not finding a place that would give us support" (P12).

"we should schedule another day for you to teach me" (P16).

Another category shows the difficulty with Technical Aspects, as expressed in the responses of six users:

"Internet issue" (P1).

"my cell phone broke" (P2).

"I changed the phone" (P6).

"there was a problem with my phone, and I lost the application" (P8).

"my phone broke" (P10).

"my phone was damaged" (P14).

It is essential to highlight that all technical aspects are related to the device and the Internet, and not to the application itself, as reinforced by P1:

"but the application would be available" (P1).

In question three, the participants' answers were categorized into Usability and Features. Usability refers to the ease of use of the system and stands out in the responses of nine users:

"these are very easy questions to be answered" (P1).

"easy, everything was on the cell phone" (P2).

"it is very intuitive" (P3).

"simple to handle and understand" (P8).

"it was practical" (P10).

"it was very easy" (P12).

In the Features category, the importance of self-management of one's health conditions emerged, which was made possible by the inherent features of the application. The potential for dietary management and tracking physical activities appeared as a significant driver for autonomy, a viewpoint emphasized by seven users.

"to have a follow-up, it is good for you to see the pressure and to do what the application asks is a good thing" (P5).

"you self-evaluate, so you try to improve increasingly every day" (P6).

"I even wrote down my walks, because at first I did not do it, take care of food, diet and exercise" (P12).

It is important to highlight support from the team and health professionals made available through the application, as seen in the following statements:

"because their service was nice" (P4).

"we could call her for anything, she was always in touch" (P10).

"she explained it straight and when I did not understand I asked her" (P11).

In question four, participant responses were categorized into New Features, Improve Usability and Technical Support. Four users suggested the new features – inclusion of diabetes control, reminders, alerts, and information:

"diabetes control" (P2).

"an exercise alert would make it much easier, because life is very busy" (P6).

"I think having a right time, that when that time came you could remember or wake up something for you to remember" (P7).

"include to control the type of food" and *"reminder on the cell phone"* (P12).

In the Improve Usability category, participants mentioned the need to be more direct in the inclusion of data, to have more explanations and for it to be simpler. Four users reported the following:

"to be direct, to have a sequence" (P8).

"to be well explained, to understand" (P9).

"simpler" (P11).

"better explanations, for me to learn" (P13).

Many users emphasized the simplicity of the application and that they could follow the sequential answers, without having to go back through the icons to enter. In the Technical Support category, bringing professionals together to assist in the use of the application was suggested. This would serve to support blood pressure checks and the entering of information. Participants highlight this factor as follows:

"often sought the basic health unit (BHU) to have an explanation and use" (P5).

"ask someone for an explanation" (P9).

DISCUSSION

The long-term experience of hypertensive patients using the m-Health app was satisfactory for most participants, although the results do not demonstrate long-term user engagement in using the app. The satisfactory experience has been related to the quality of the user interface *i.e.*, its usability. The interface is easy to use, practical and intuitive (Oliveira *et al.*, 2020; Hassenzahl; Tractinsky, 2006). Good usability is essential for the success of m-Health applications, especially in remote patient monitoring applications (Baig; GholamHosseini; Ahmad, 2020).

Functionalities that allow self-management of health conditions as well as support from the team and health professionals also contributed to a satisfactory experience for the participants, as observed in other studies (Biduski *et al.*, 2020; França *et al.*, 2020). By including features that allow the recording of health-related data, m-Health applications can help patients self-manage their health conditions and thus improve self-assessment, monitor treatment, and favor empowerment (Liang *et al.*, 2018; Lu *et al.*, 2019; Oliveira *et al.*, 2018). Such elements provide a positive bond to the user and awaken the importance of self-care (Paula *et al.*, 2020).

Providing simple and easy-to-use applications is a fundamental strategy for positive experiences in using the solution and, consequently, for user engagement (Silva *et al.*, 2018). Many participants affirmed that the application presents easy and intuitive questions, which made it possible to use it with little explanation. Users value products based on how they can satisfy their needs in specific situations, so the experience is related to the expectation of this user (Biduski *et al.*, 2020). In addition, it is necessary to create an affective bond and awaken feelings of pleasure (Santana; Ferreira; Berretta, 2021) through features available in the application. For example, in eLifestyle, the information is available on the cell phone, and users can access it at any time to follow the evolution of their health conditions.

Although the satisfactory experiences stood out against the unsatisfactory ones, three aspects contributed to the users not being engaged with use of the app. The first aspect, the user's inability to use the technology, was reported by four users and may be associated with the participants' older age and low level of education. For example, in the study by Rao and Joshi (2020), in which 15 older adults were interviewed about their attitudes and knowledge in using technology to support them in monitoring health conditions, most participants were also unfamiliar with the tools they could use to manage their health. Other studies also

observed comparable results (Cunha; Rodrigues; Pimentel, 2019; Giassi; Seabra, 2019; Zongliang; Guang; Ping, 2020). Malone (2013) suggested that the low score assigned to the applications could be attributed to the user's inability to communicate and understand the guidelines. Users give low ratings to products they can't use because they don't see value in them and get frustrated. Frustration substantially affects the user's impression of something, as it is reflected as an intense negative moment that impacts the human mind (Kane, 2018). For people, a single moment of negative/bad experience is more important than thousands of moments of good experience.

The second aspect, the lack of follow-up and support, was reported by three users who ended up requiring the help of another person who was not always available. This has also been reported in other studies (Amagai *et al.*, 2022; Serrão; Veiga, 2020; Silva *et al.*, 2020). In Serrão and Veiga (2020), 33 older adults were interviewed about the use of technologies, health instructions and the support received. Most participants reported the support of health professionals as a source of greater security, motivation for self-care, and adherence to treatment. Staying connected with users is a crucial factor for the use of m-Health applications. Constant approximation of the health professional to the user and feedback on how the health prognosis is evolving with the application are important strategies for adherence to the application (Oliveira *et al.*, 2020; Scotton; Barletta; Neufeld, 2021).

The third and final aspect, related to technical issues, was reported by six participants. Technical issues can happen when technology is used, so it is crucial to have support when needed. Participants' inability to communicate and understand app instructions result in a low rating (Malone, 2013). A user assigns a low score to something they cannot use, as they fail to perceive its value, resulting in a negative emotional response. Technical functionalities are essential for proper functioning, but when it comes to technology, interference may occur on the device and the Internet. This can be seen in the study by Biduski *et al.* (2020), where 37 participants reported their experience with m-Health applications and the availability of the Internet was a fundamental factor.

Technical issues may also have been responsible for users' inability to use the app. Half of the participants had problems with the internet and/or had to change their smartphone during the period of use. Device or internet problems are beyond the application developer's ability and cannot be controlled in the study. However, the application was not yet available for download in the app stores, which made it impossible to download updates or install it on a new device. Park *et al.* (2019) reported unsatisfactory customer service and updates, when identifying technical difficulties as a negative aspect of the user experience. Also, the application in this study did not have a feature in which users could report problems or receive guidance on how to use it. The lack of educational integration in apps, with generic and impersonal information, is an important limitation for patient engagement (Jeffrey *et al.*, 2019).

The improvements discussed by the participants are related to expanding the scope of the application. They suggested including management features for new diseases as well as reminders and alerts for application use. Therefore, there is motivation to use the application, but studies need to consider the individual needs of the users, and investigate the use of different resources, especially regarding support techniques such as reminders to use the application every day. Suitable reminders are essential means of interaction to reinforce the use of the app and thus increase engagement (Olaniyi *et al.*, 2022).

Participants also suggested a more direct way of including data, despite pointing out the application's simplicity. The idea is to reduce effort by including data daily and even make the relationship between users and applications more affective. Some studies show that voice interaction is a viable option for efficiency, ease of use and understanding, in addition to utility (Kim, 2021; Kowalski *et al.*, 2019; O'Brien *et al.*, 2020; Ziman; Walsh, 2018) and can be an alternative for the easier insertion of health-related data. The simplicity

of the application is a crucial factor, because when it comes to the elderly user, the simpler it is to enter the information, the more interesting the application becomes (Silva *et al.*, 2018).

The results of the interviews showed that there was no long-term adherence one year after the study conducted by Volpi *et al.* (2021). For considerable user engagement, the use of the application must become a habit, which did not happen. Habit is one of the factors that motivates the patient to adhere to the use of technology (Ware *et al.*, 2019). Instead, participants reported forgetfulness regarding use of the app and laxity in continuing to use it. Such reports may be associated with manifestations of resistance to the treatment format, or clinical issues of the user, such as anxiety, depression, anguish, and stressful experiences, which can be factors that trigger forgetfulness, especially when they are linked to the harmful effects of the covid-19 pandemic. The study by Zerbes and Schwabe (2021), showed that stressors can interfere with memory.

Applications are an emerging technological resource, and not everyone assimilates them as something routine. For this reason, it is first necessary to develop the habit or make their use familiar so that day-to-day variables do not interfere with use. In the participants' reports, it is possible to observe that there was no perception of usefulness, with day-to-day activities being considered more important. Warren and Reimann's (2019) research with 240 participants, showed that uncommon designs grab the users' attention more and are considered cooler and more desirable, if they also make sense to the user.

According to Park (2020), affective meanings, such as attractiveness, associated with specific devices and technologies, make users more likely to use them. Furthermore, the attraction created by aesthetic characteristics influences individuals' hedonic and utilitarian values when using a specific device or service (Kim; Park, 2019). Therefore, for the technology to become attractive, it needs to be close to the user's needs and involve the affectivity of this audience.

Affective aspects are essential for users' experience (Hassenzahl; Tractinsky, 2006; Santana; Ferreira; Berretta, 2021). When the app is used, a momentary experience is influenced by perceptions, motivations, and cognitions, which can change over time. For example, emotional responses influence positive or negative experiences, and lack of engagement with the application is associated with user perception, being subjective and psychological, as evidenced in other studies (Santana; Ferreira; Berretta, 2021).

Lack of engagement is a recurring problem in the use of m-Health applications (AMAGAI *et al.*, 2022; Kim; Hwang; Tregarthen, 2021; Torous *et al.*, 2020), and in this study the profile of participants may have strongly contributed to this topic. The patients were from the public health network, with low education and income. In this scenario, the challenge is to find strategies that can keep users motivated to use the application over time, showing its value as a support tool for improving health conditions. This study showed that gamification was insufficient to maintain long-term user engagement. Participants rarely mentioned it as a necessary or enjoyable feature. This was in contrast to techniques found in Cognitive Therapy (CT), such as reminders and alerts. The eLifestyle app also sends reminders, but only if registered by the users themselves directly in the app.

Issuing periodic alerts to encourage behavior change was a strategy adopted by Kim *et al.* (2020), when including CT techniques in her mobile application intervention. In the study with 70 participants, the technique was viable to remind and motivate the user and, consequently, change their behavior. Likewise, Purkayastha, Addepally and Bucher (2020), also used the reinforcement recommended by CT by issuing notifications and reminders in the application when participants did not reach a determined cutoff score or did not complete the activity. Furthermore, the study with 30 participants showed that the technique encouraged the use of the application during the eight weeks of intervention.

Another effective approach was the application of associative learning techniques from CT. These techniques involve both reflective and automatic motivational processes that regulate behavior, as

illustrated by Conroy and Kim (2021). The authors conducted a study with six participants using images of physical activities with affective and pleasant adjectives displayed on cell phone lock screens. As a result, participants associated physical activity with something good and increased their engagement in activities.

In addition to the reinforcers described a support mechanism which acts as an alternative means of enhancing engagement is the insertion of forms of interaction between users. It is also recommended to investigate the use of chatbots. Chatbots have become popular in recent years as they enable more natural forms of interaction, which could facilitate the inclusion of health data. However, while they show promise, their use for health promotion needs more investment to improve solutions and evaluate their effectiveness (Barreto *et al.*, 2021). Furthermore, knowing which audience will use the application is essential for adapting digital resources to the reality and needs of users (Guimarães; Dos Santos; Fontana, 2017).

This study showed positive alternatives for psychoeducational, modeling, associative learning, and reinforcement techniques. Moreover, these techniques should be increasingly related to and studied with interventions in Digital Health, as cited by the WHO (2019). Only with great user engagement will m-Health apps be effective in changing behavior.

This study has some limitations. We had difficulty enrolling a more substantial number of volunteer participants, as 12 months had passed since the intervention. The use of a closed-ended interview and the absence of a multimethod assessment may have limited the findings.

CONCLUSION

The results of this study showed that, despite the satisfactory experience with the application, after one year, there was no user engagement in using the m-Health application. Among the factors contributing to lack of engagement, user inability and lack of follow-up and support are cited. This can be understood as a reinforcement of the stimuli for the treatment and use.

The technology has limitations that can be alleviated with the involvement of the health team, which plays a fundamental role in creating a bond with the application and in minimizing problems related to issues that make its use difficult. It is essential to know the behavioral characteristics of users, their motivations for treatment and their level of involvement in their health care when proposing an intervention with the use of m-Health. Their expectations and needs are related to a satisfactory UX which can lead to long-term engagement, showing the importance of health teams in adherence to treatment.

It is necessary to understand the engagement process more broadly and for the health team to adopt new strategies so that the technology can be an ally to the treatment, enhancing the patient's adherence to treatment with the app. Treatment adherence is a complex and dynamic process essential for the effectiveness of treatment, associated with the patient's habits and their agreement with the recommendations proposed by the health team. Therefore, issues such as access to treatment, socioeconomic conditions, the relationship between the patient and the health team, and aspects of the patient's personality and treatment adaptations must be considered. Furthermore, it is important to know the technical difficulties that make it impossible to access the use of the app and the measures found by users to solve these problems.

Finally, in this study, gamification was not enough to keep the user engaged after 12 months. Future studies are recommended to evaluate the use of combined techniques, including those proposed by Cognitive Therapy and that also include the health team. These should be combined with evaluations of the characteristics of the individual's persistent behavior, their mental health conditions, including aspects related to mood as well as their expectations and needs related to the use of the application. Furthermore, it is recommended to evaluate engagement based on more periodic assessments every three months, as more systematic professional follow-up can be a motivating factor for user engagement.

REFERENCES

ALBINI, Fabio *et al*. An ICT and mobile health integrated approach to optimize patients' education on hypertension and its management by physicians: The Patients Optimal Strategy of Treatment (POST) pilot study. *In:* ANNUAL INTERNATIONAL CONFERENCE OF THE IEEE ENGINEERING IN MEDICINE AND BIOLOGY SOCIETY, 38., 16-20 Aug. 2016, Orlando. **Proceedings** [...] Orlando: IEEE, 2016. DOI: https://doi.org/10.1109/EMBC.2016.7590753. Available from: https://ieeexplore.ieee.org/document/7590753. Accessed: 15 Feb. 2022.

AMAGAI, Saki *et al*. Challenges in participant engagement and retention using mobile health apps: literature review. **Journal of Medical Internet Research**, Toronto, v. 24, n. 4, p. e35120, 2022. DOI: https://doi.org/10.2196/35120. Available from: https://www.jmir.org/2022/4/e35120. Accessed: 20 Mar. 2022.

ASHOORKHANI, Mahnaz *et al*. Comparing the effectiveness of the BPMAP (Blood Pressure Management Application) and usual care in self-management of primary hypertension and adherence to treatment in patients aged 30-60 years: study protocol for a randomized controlled trial. **Trials**, London, v. 17, n. 1, p. 511, 21 dez. 2016. DOI: https://doi.org/10.1186/s13063-016-1638-0. Available from: https://trialsjournal.biomedcentral.com/articles/10.1186/s13063-016-1638-0. Accessed: 17 Mar. 2022.

ASSMANN, Márcia Prante; ZANATTA, Alexandre Lazaretti; DE MARCHI, Ana Carolina Bertoletti. Long-term user experience in software crowdsourcing platform. *In*: BRAZILIAN SYMPOSIUM ON HUMAN FACTORS IN COMPUTING SYSTEMS, 20., 2021, online. **Proceedings** […]. New York: Association for Computing Machinery, 2021. p. 1-7. DOI: https://doi.org/10.1145/3472301.3484342. Available from: https://doi.org/10.1145/3472301.3484342. Accessed: 12 Jun. 2022.

BAIG, Mirza Mansoor; GHOLAMHOSSEINI, Hamid; AHMAD, Farhan. A usability and user-experience analysis of VitalsAssist: a mHealth application to monitor vital signs in acute care settings. *In*: ANNUAL INTERNATIONAL CONFERENCE OF THE IEEE ENGINEERING IN MEDICINE AND BIOLOGY SOCIETY, 42., 2020, Montreal. **Proceedings** […]. Orlando: IEEE, 2020. p. 5132-5135. DOI: https://doi.org/10.1109/EMBC44109.2020.9176467. Available from: https://doi.org/10.1109/EMBC44109.2020.9176467. Accessed: 14 Jul. 2022.

BARDIN, Laurence. **Análise de conteudo**. 5. ed. Coimbra: Edições 70, 2008.

BARRETO, Ivana Cristina de Holanda Cunha *et al*. Desenvolvimento e avaliação do protótipo da aplicação GISSA ChatBot Mamãe-Bebê para promoção da saúde infantil. **Ciência & Saúde Coletiva**, Rio de Janeiro, v. 26, n. 5, p. 1679-1690, 2021. DOI: https://doi.org/10.1590/1413-81232021265.04072021. Available from: https://www.scielo.br/j/csc/a/HGwWTZGbC5zfHXsTqNFkYnM/?lang=pt. Accessed: 14 Mar. 2022.

BIDUSKI, Daiana *et al*. Assessing long-term user experience on a mobile health application through an in-app embedded conversation-based questionnaire. **Computers in Human Behavior**, [*s. l.*], v. 104, p. 1-15, 2020. DOI: https://doi.org/10.1016/j.chb.2019.106169. Available from: https://www.sciencedirect.com/science/article/pii/S0747563219303814. Accessed: 25 Feb. 2022.

CECHETTI, Nathália Pinto *et al*. Developing and implementing a gamification method to improve user engagement: A case study with an m-Health application for hypertension monitoring. **Telematics and Informatics**, [*s. l.*], v. 41, p. 126-138, 2019. DOI: https://doi.org/10.1016/J.TELE.2019.04.007. Available from: https://www.sciencedirect.com/science/article/pii/S0736585318312656?via%3Dihub. Accessed: 21 Feb. 2022.

CONROY, David E.; KIM, Ian. HeartPhone: mobile evaluative conditioning to enhance affective processes and promote physical activity. **Health Psychology**, State College, v. 40, n. 12, p. 988-997, 2021. DOI: https://doi.org/10.1037/hea0000886. Available from: https://psycnet.apa.org/doiLanding?doi=10.1037%2Fhea0000886. Accessed: 13 Mar. 2022.

CUNHA, Bruna C. R.; RODRIGUES, Kamila R. H.; PIMENTEL, Maria da Graça C. Synthesizing guidelines for facilitating elderly-smartphone interaction. *In*: BRAZILLIAN SYMPOSIUM ON MULTIMEDIA AND THE WEB, 25., 2019, Rio de Janeiro. **Proceedings** […]. New York: Association for Computing Machinery, 2019. p. 37-44. DOI: https://doi.org/10.1145/3323503.3349563. Available from: https://dl.acm.org/doi/10.1145/3323503.3349563. Accessed: 5 Apr 2022.

DE MARCHI, Ana Carolina Bertoletti *et al*. An electronic health platform for monitoring health conditions of patients with hypertension in the Brazilian public health system: Protocol for a nonrandomized controlled trial. **JMIR Research Protocols**, Toronto, v. 9, n. 1, p. e15299, 20 jan. 2020. DOI: https://doi.org/10.2196/15299. Available from: https://www.researchprotocols.org/2020/1/e15299/. Accessed: 10 Feb. 2022.

FRANÇA, Maria Luísa Fagundes et al. Suporte ao enfrentamento das doenças crônicas realizado pelo Núcleo de Telessaúde de Santa Catarina. **Brazilian Applied Science Review**, São José dos Pinhais, v. 4, n. 4, p. 2187-2203, 2020. DOI: https://doi.org/10.34115/basrv4n4-006. Available from: https://ojs.brazilianjournals.com.br/ojs/index.php/BASR/article/view/12808. Accessed: 23 Apr. 2022.

GIASSI, Beatriz Hencklein; SEABRA, Rodrigo Duarte. Usability assessment of the Instagram application on smartphones with emphasis on elderly users. *In*: BRAZILIAN SYMPOSIUM ON HUMAN FACTORS IN COMPUTING SYSTEMS, 18., 2019, Rio de Janeiro. **Proceedings** […]. New York: Association for Computing Machinery, 2019. p. 1-4. DOI: https://doi.org/10.1145/3357155.3360470. Available from: https://dl.acm.org/doi/10.1145/3323503.3349563. Accessed: 7 Mar. 2022.

GUIMARÃES, Cayley; DOS SANTOS, Leandro Augusto Ferras; FONTANA, Isabela Mantovani. Design & Engenharia de Usabilidade: aplicação prática na criação de um aplicativo. **Design e Tecnologia**, Porto Alegre, v. 7, n. 14, p. 11-29, 2017. DOI: https://doi.org/10.23972/det2017iss14pp11-29. Available from: https://www.ufrgs.br/det/index.php/det/article/view/420. Accessed: 15 Feb 2022.

HASSENZAHL, Marc; TRACTINSKY, Noam. User experience: a research agenda. **Behaviour and Information Technology**, [*s. l.*], v. 25, n. 2, p. 91-97, 2006. DOI: https://doi.org/10.1080/01449290500330331. Available from: https://www.tandfonline.com/doi/abs/10.1080/01449290500330331. Accessed: 12 Mar. 2022.

JEFFREY, Bronte *et al*. Mobile phone applications and their use in the self-management of Type 2 Diabetes Mellitus: a qualitative study among app users and non-app users. **Diabetology & Metabolic Syndrome**, London, v. 11, n. 1, 2019. DOI: https://doi.org/10.1186/S13098-019-0480-4. Available from: https://dmsjournal.biomedcentral.com/articles/10.1186/s13098-019-0480-4. Accessed: 26 Feb. 2022.

KANE, Lexie. The peak-end rule: how impressions become memories. **Nielsen Norman Group**, Dover, 30 Dec. 2018. Available from: https://www.nngroup.com/articles/peak-end-rule/. Accessed: 11 Jan. 2023.

KIM, Jane Park; HWANG, Jisung; TREGARTHEN, Jenna. Engagement patterns of users and providers: a study of messaging on app usage in a smartphone app for the treatment of eating disorders. **Journal of Technology in Behavioral Science**, [*s. l.*], v. 6, n. 4, p. 572-577, 2021. DOI: https://doi.org/10.1007/s41347-021-00220-8. Available from: https://link.springer.com/article/10.1007/s41347-021-00220-8. Accessed: 9 Mar. 2022.

KIM, Jina; PARK, Eunil. Beyond coolness: predicting the technology adoption of interactive wearable devices. **Journal of Retailing and Consumer Services**, [*s. l.*], v. 49, p. 114-119, 2019. DOI: https://doi.org/10.1016/j.jretconser.2019.03.013. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0969698918309044?via%3Dihub. Accessed: 26 Feb. 2022.

KIM, Meelin *et al*. Multidimensional cognitive behavioral therapy for obesity applied by psychologists using a digital platform: open-label randomized controlled trial. **JMIR Mhealth Uhealth**, v. 8, n. 4, p. e14817, 2020. DOI: https://doi.org/10.2196/14817. Available from: https://mhealth.jmir.org/2020/4/e14817. Accessed: 20 Mar. 2022.

KIM, Sunyoung. Exploring how older adults use a smart speaker-based voice assistant in their first interactions: qualitative study. **JMIR mHealth and uHealth**, Toronto, v. 9, n. 1, p. e20427, 2021. DOI: https://doi.org/10.2196/20427. Available from: https://mhealth.jmir.org/2021/1/e20427/. Accessed: 18 Apr. 2022.

KOWALSKI, Jaroslav *et al*. Older adults and voice interaction: a pilot study with Google Home. *In*: CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS, 2019, Glasgow. **Proceedings** […]. New York: Association for Computing Machinery, 2019. p. 1-6. DOI: https://doi.org/10.1145/3290607.3312973. Available from: https://dl.acm.org/doi/10.1145/3290607.3312973. Accessed: 19 Mar. 2022.

KUJALA, Sari *et al*. Identifying hedonic factors in long-term user experience. *In*: 2011 CONFERENCE ON DESIGNING PLEASURABLE PRODUCTS AND INTERFACES, 2011, Milano. **Proceedings** […]. New York: Association for Computing Machinery, 2012. p. 1-8. DOI: https://doi.org/10.1145/2347504.2347523. Available from: https://dl.acm.org/doi/10.1145/2347504.2347523. Accessed: 31 Oct. 2023.

LIANG, Jun *et al*. Chinese mobile health APPs for hypertension management: a systematic evaluation of usefulness. **Journal of Healthcare Engineering**, Essex, v. 2018, p. 1-14, 2018. DOI: https://doi.org/10.1155/2018/7328274. Available from: https://www.hindawi.com/journals/jhe/2018/7328274/. Accessed: 12 Feb. 2022.

LU, Xiomei *et al*. Interactive mobile health intervention and blood pressure management in adults: A meta-analysis of randomized controlled trials. **Hypertension**, Hagerstown, v. 74, n. 3, p. 697-704, 2019. DOI: https://doi.org/10.1161/HYPERTENSIONAHA.119.13273. Available from: https://www.ahajournals.org/doi/10.1161/HYPERTENSIONAHA.119.13273. Accessed: 24 Mar. 2022.

MALONE, Meghan. Is there an app for that? Developing an evaluation rubric for apps for use with adults with special needs. **The Journal of BSN Honors Research**, Lawrence, v. 6, n. 1, p. 38-56, 2013. Available from: https://kuscholarworks.ku.edu/bitstream/handle/2271/1181/2271-333-JBSNR-2013-Malone.pdf?sequence=1&isAllowed=y. Accessed: 1 Nov. 2023.

MARTI, Patrizia; IACONO, Iolanda. Anticipated, momentary, episodic, remembered: the many facets of user eXperience. *In*: 2016 FEDERATED CONFERENCE ON COMPUTER SCIENCE AND INFORMATION SYSTEMS, 11-14 Sept. 2016, Gdansk. **Proceedings** […]. [*S. l.*]: IEEE Xplore, 2016. p. 1647-1655. Available from: https://doi.org/10.15439/2016F302. Accessed: 8 Mar. 2022.

O'BRIEN, Katherine et al. Voice-controlled intelligent personal assistants to support aging in place. **Journal of the American Geriatrics Society**, Malden, v. 68, n. 1, p. 176-179, 2020. DOI: https://doi.org/10.1111/JGS.16217. Available from: https://agsjournals.onlinelibrary.wiley.com/doi/10.1111/jgs.16217. Accessed: 14 Apr. 2022.

OLANIYI, Babaniyi Yusuf *et al*. User engagement in mobile health applications. *In:* ACM SIGKDD CONFERENCE ON KNOWLEDGE DISCOVERY AND DATA MINING, 28., 2022, Washington, DC. **Proceedings** […]. New York: Association for Computing Machinery, 2022. p. 4704-4712. DOI: https://doi.org/10.1145/3534678.3542681. Available from: https://dl.acm.org/doi/10.1145/3534678.3542681. Accessed: 24 Mar. 2022.

OLIVEIRA, Lara Bezerra *et al*. Aplicativos móveis no cuidado em saúde: uma revisão integrativa. **Revista Enfermagem Atual**, Rio de Janeiro, v. 93, n. 31, p. 1-9, 2020. DOI: https://doi.org/10.31011/reaid-2020-v.93-n.31-art.760. Available from: https://teste.revistaenfermagematual.com/index.php/revista/article/view/760. Accessed: 27 Oct. 2023.

OLIVEIRA, Leyla Márcia Ramos *et al*. Tecnologia mHealth na prevenção e no controle de obesidade na perspectiva do letramento em saúde: Lisa Obesidade. **Saúde em Debate**, Rio de Janeiro, v. 42, n. 118, p. 714-723, 2018. DOI: https://doi.org/10.1590/0103-1104201811814. Available from: https://www.scielo.br/j/sdeb/a/4T7BNNR4fVDXXLwkbDxbnfL/?lang=pt#. Accessed: 4 Feb 2022.

PALMEIRA, Lana Lisiêr de Lima; CORDEIRO, Carla Priscilla Barbosa Santos; PRADO, Edna Cristina do. A análise de conteúdo e sua importância como instrumento de interpretação dos dados qualitativos nas pesquisas educacionais. **Cadernos de Pós-Graduação**, São Paulo, v. 19, n. 1, p. 14-31, 2020. DOI: https://doi.org/10.5585/cpg.v19n1.17159. Available from: https://periodicos.uninove.br/cadernosdepos/article/view/17159. Accessed: 7 Mar 2022.

PARK, Eunil. Understanding the social adoption of smart TVs: the key role of product coolness. **Universal Access in the Information Society**, Berlin, v. 19, n. 3, p. 595-602, 2020.

PARK, Jamie Yea Eun *et al*. Mobile phone apps targeting medication adherence: quality assessment and content analysis of user reviews. **JMIR Mhealth Uhealth,** Toronto, v. 7, n. 1, p. e11919, 2019. DOI: https://doi.org/10.2196/11919. Available from: https://mhealth.jmir.org/2019/1/e11919/. Accessed: 24 Mar. 2022.

PAULA, Thais Rodrigues *et al*. Effectiveness of mobile applications for behavioral changes in health: a systematic review. **Rev Rene**, Fortaleza, v. 21, p. e43845, 2020. DOI: https://doi.org/10.15253/2175-6783.20202143845. Available from: http://periodicos.ufc.br/rene/article/view/43845. Accessed: 14 Feb. 2022.

PURKAYASTHA, Saptarshi; ADDEPALLY, Siva Abhishek; BUCHER, Sherri. Engagement and usability of a cognitive behavioral therapy mobile app compared with web-based cognitive behavioral therapy among college students: randomized heuristic trial. **JMIR Human Factors**, Toronto, v. 7, n. 1, p. e14146, 2020. DOI: https://doi.org/10.2196/14146. Available from: https://humanfactors.jmir.org/2020/1/e14146/. Accessed: 26 Apr. 2022.

RAO, Pallavi; JOSHI, Anirudha. Design opportunities for supporting elderly in India in managing their health and fitness post-covid-19. *In*: INDIAN CONFERENCE ON HUMAN-COMPUTER INTERACTION, 11., Nov. 5-8, 2020, online. **Proceedings** […]. New York: Association for Computing Machinery, 2020. p. 34-41. Available from: https://dl.acm.org/doi/10.1145/3429290.3429294. Accessed: 31 Oct. 2023.

SANTANA, Rosângela Divina de Sousa; FERREIRA, Deller James; BERRETTA, Luciana de Oliveira. Conceitualização e medida do quanto a experiência do usuário pode ser cool: uma revisão sistemática da literatura. **Brazilian Journal of Development**, São José dos Pinhais, v. 7, n. 1, p. 6674-6691, 2021. DOI: https://doi.org/10.34117/bjdv7n1-452. Available from: https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/article/view/23359. Accessed: 25 Mar. 2022.

SCOTTON, Isabela Lamante; BARLETTA, Janaína Bianca; NEUFELD, Carmem Beatriz. Competências essenciais ao terapeuta cognitivo-comportamental. **Psico-USF**, São Paulo, v. 26, n. 1, p. 141-152, 2021. DOI: https://doi.org/10.1590/1413-82712021260112. Available from: https://www.scielo.br/j/pusf/a/vDnkWQYxXkdQf3gvpY7dmxr/?lang=pt. Accessed: 17 Apr. 2022.

SERRÃO, Carla; VEIGA, Sofia. Fontes de informação sobre saúde: Resultados obtidos junto de um grupo de pessoas idosas. **Sensos-e**, Porto, v. 7, n. 2, p. 134-142, 2020. DOI: https://doi.org/10.34630/sensose.v7i2.3677. Available from: https://parc.ipp.pt/index.php/sensos/article/view/3677. Accessed: 19 Feb. 2022.

SHIN, Dong-Hee; LEE, Seungjo; HWANG, Yujong. How do credibility and utility play in the user experience of health informatics services? **Computers in Human Behavior**, [*s. l.*], v. 67, p. 292-302, 2017. DOI: https://doi.org/10.1016/j.chb.2016.11.007. Available from: https://www.sciencedirect.com/science/article/pii/S0747563216307488?via%3Dihub. Accessed: 21 Mar. 2022.

SILVA, Andressa Hennig; FOSSÁ, Maria Ivete Trevisan. Análise de conteúdo: exemplo de aplicação da técnica para análise de dados qualitativos. **Qualitas Revista Eletrônica**, Campina Grande, v. 16, n. 1, p. 1-14, 2015.

SILVA, Rafael Henrique da *et al*. Aplicativos de saúde para dispositivos móveis: Uma revisão integrativa / Health applications for mobile devices: An integrative review. **Brazilian Journal of Health Review**, São José dos Pinhais, v. 3, n. 5, p. 11754-11765, 2020. DOI: https://doi.org/10.34119/bjhrv3n5-033. Available from: https://ojs.brazilianjournals.com.br/ojs/index.php/BJHR/article/view/16152. Accessed: 23 Mar. 2022.

SILVA, Rômulo Santos *et al*. Avaliação da experiência da terceira idade com realidade virtual na área de jogos digitais para *smartphone*. *In*: BRAZILIAN SYMPOSIUM ON COMPUTER GAMES AND DIGITAL ENTERTAINMENT, 8., 2018, Foz do Iguaçu. **Proceedings** […], [*s. l.*], p. 79-87, 2018. Available from: https://www.sbgames.org/sbgames2018/files/papers/ArtesDesignFull/187142.pdf. Accessed: 3 Nov. 2023.

TORO-RAMOS, Tatiana *et al*. Effectiveness of a smartphone application for the management of metabolic syndrome components focusing on weight loss: a preliminary study. **Metabolic Syndrome and Related Disorders**, Larchmont, v. 15, n. 9, p. 465-473, 2017. DOI: https://doi.org/10.1089/met.2017.0062. Available from: https://www.liebertpub.com/doi/10.1089/met.2017.0062. Accessed: 19 Feb. 2022.

TOROUS, John *et al*. Dropout rates in clinical trials of smartphone apps for depressive symptoms: a systematic review and meta-analysis. **Journal of Affective Disorders**, Amsterdam, v. 263, p. 413-419, 2020. DOI: https://doi.org/10.1016/J.JAD.2019.11.167. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0165032719326060?via%3Dihub. Accessed: 18 Mar. 2022.

TUBIN, Carla; MAZUCO RODRIGUEZ, João Pedro; DE MARCHI, Ana Carolina Bertoletti. User experience with conversational agent: a systematic review of assessment methods. **Behaviour & Information Technology**, [*s. l.*], v. 41, n. 16, p. 1-11, 2021. DOI: https://doi.org/10.1080/0144929X.2021.2001047. Available from: https://www.tandfonline.com/doi/full/10.1080/0144929X.2021.2001047. Accessed: 21 Feb. 2022.

VERMEEREN, Arnold P. O. S. *et al*. User experience evaluation methods: Current state and development needs. *In*: NORDIC CONFERENCE ON HUMAN-COMPUTER INTERACTION, 6., 2010, Reykjavik. **Proceedings** […]. New York: Association for Computing Machinery, 2010. p. 521-530. DOI: https://doi.org/10.1145/1868914.1868973. Available from: https://doi.org/10.1145/1868914.1868973. Accessed: 9 Apr 2022.

VOLPI, Simiane Salete *et al*. Using a mobile health app to improve patients' adherence to hypertension treatment: a non-randomized clinical trial. **PeerJ**, Corte Madera, v. 9, p. e11491, 2021. DOI: https://doi.org/10.7717/PEERJ.11491. Available from: https://peerj.com/articles/11491/. Accessed: 16 Apr. 2022.

WARE, Patrick *et al*. Patient adherence to a mobile phone–based heart failure telemonitoring program: a longitudinal mixed-methods study. **JMIR Mhealth Uhealth,** Toronto, v. 7, n. 2, p. e13259, 2019. DOI: https://doi.org/10.2196/13259. Available from: https://mhealth.jmir.org/2019/2/e13259. Accessed: 17 Mar. 2022.

WARREN, Caleb; REIMANN, Martin. Crazy-funny-cool theory: divergent reactions to unusual product designs. **Journal of the Association for Consumer Research**, Chicago, v. 4, n. 4, p. 409-421, 2019. DOI: https://doi.org/10.1086/705036. Available from: https://www.journals.uchicago.edu/doi/10.1086/705036. Accessed: 19 Feb. 2022.

WORLD HEALTH ORGANIZATION (WHO). **WHO guideline:** recommendations on digital interventions for health system strengthening. Genebra: WHO, 2019. Available from: https://iris.who.int/bitstream/handle/10665/311941/9789241550505-eng.pdf?sequence=31. Accessed: 27 Oct. 2023.

ZAROUR, Mohammad; ALHARBI, Mubarak. User experience aspects and dimensions: systematic literature review. **International Journal of Knowledge Engineering**, [*s. l.*], v. 3, n. 2, p. 52-59, 2017. DOI: https://doi.org/10.18178/IJKE.2017.3.2.087. Available from: http://www.ijke.org/index.php?m=content&c=index&a=show&catid=47&id=133. Accessed: 26 Feb. 2022.

ZERBES, Gundula; SCHWABE, Lars. Stress-induced bias of multiple memory systems during retrieval depends on training intensity. **Psychoneuroendocrinology**, Oxford, v. 130, p. 105281, 2021. DOI: https://doi.org/10.1016/J.PSYNEUEN.2021.105281. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0306453021001554?via%3Dihub. Accessed: 14 Apr. 2022.

ZIMAN, Randall; WALSH, Greg. Factors affecting seniors' perceptions of voice-enabled user interfaces. *In*: CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS, 2018, Montreal. **Proceedings** […]. New York: Association for Computing Machinery, 2018. p. 1-6. DOI: https://doi.org/10.1145/3170427.3188575. Available from: https://dl.acm.org/doi/10.1145/3170427.3188575. Accessed: 16 Mar. 2022.

ZONGLIANG, Bao; GUANG, Feng; PING, Wu. Elderly-oriented design of user interface of agedness internet products based on synesthesia thinking. *In:* WORLD SYMPOSIUM ON SOFTWARE ENGINEERING, 2., 2020, Chengdu. **Proceedings** […]. New York: Association for Computing Machinery, 2020. p. 51-54. DOI: https://doi.org/10.1145/3425329.3425393. Available from: Accessed: 17 Feb. 2022.