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A USER-CENTERED APPROACH: EVALUATION OF A UNIVERSAL PORTABLE GRAND BAR

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SUMMARY: A considerable portion of the world's population is made up of people with disabilities, which leads to difficulties in carrying out activities of daily living. In addition to these difficulties, there is also the risk of accidents due to falls, in the case of people with physical disabilities. An example is the transfer of wheelchair users and elderly people, mainly in the context of the bathroom, in the toilet. For this reason, this work aimed to evaluate a universal portable grab bar through a user-centered approach, taking as a sample two volunteer users: the first female, aged 61 years, with mobility impairment problems due to falls, and the second is a 60-year-old male who has a motor disability and uses a motorized wheelchair. An observation was carried out in a real context of product use with the participants, including video recordings, timing and information collected through a questionnaire. Regarding the evaluation, it was observed that the portable support bar presented functionality problems, identified in the failure of the fixation, with its functionality only being possible through the insertion of two adapted plastic locks. Usability problems include the instruction manual in English, the lack of identification of the materials in which the bar can be used, and the lack of information regarding the average fixation time of the product. The great contribution of the study was to evaluate an Assistive Technology product for people with disabilities.

KEYWORDS: People with Disabilities; Usability; Assistive Technology.

INTRODUCTION

A considerable portion of the world's population has some disability, and Brazil is no different. According to the 2010 Demographic Census, approximately 46 million Brazilians, around 23.9% of the population, declared having some degree of difficulty in at least one of the skills

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investigated (seeing, hearing, walking or climbing steps), or having mental/intellectual disability. (BRAZIL, 2012; IBGE, 2019).

In the elderly population, with the decline in physical, cognitive and emotional capacity, a series of difficulties are observed, including motor coordination, often due to arthritis that demands care and changes (BATISTA; WIBELINGER, 2011; SALES, 2002), which interfere in daily activities.

People with Disabilities (PwD) require special care, and it is important to consider this group in the various aspects of health. (ARAUJO; FERNANDES, 2020; PASSINATO, 2021). Therefore, it is essential to take actions to mitigate this risk, as is the case with the hygiene of devices used to perform Activities of Daily Living (ADL), whether of low or high complexity. Activities of Daily Living are basic self-care tasks, which include eating, going to the bathroom, choosing clothes, grooming and taking care of personal hygiene, dressing, bathing, walking and transferring (SBGG, 2021) . When you are a PwD, some activities become risky in terms of safety from injuries and fractures, especially those carried out in wet environments, which can result in accidents (DUCA; SILVA; HALLAL, 2009; CASTRO et al., 2016).

Neto et al (2018) verified the main household risk factors related to falls, one of the most common being a slippery or unprotected bathroom. The need to design well-planned products for fall protection in slippery environments is understood, as it is necessary to meet the needs of these people. It is known that People with Disabilities (PwD), specifically physical disabilities, have a high risk of falling (SAVERINO; MORIARTY; PLYFORD, 2014).

Chen et al. (2011) carried out a study with 95 participants in which 87% of wheelchair users reported at least one accidental touch, that is, bumping into objects or falling in the last three years. Xiang et al. (2006) in their studies found that 100,000 wheelchair accidents occur every year in the USA in hospital environments, with 65 to 80% of accidents being due to user falls.

According to Brechtelsbauer and Louie (1999), elderly wheelchair users tend to suffer more accidents related to transfer, whether carried out to the wheelchair or out of the wheelchair, with an increased mortality rate, decreased mobility and consequent impairment of quality of life.

In his study, Tsai (2020) reported that 61.8% of wheelchair accidents that cause fractures occur when transferring out of the wheelchair. The author identified that this decline occurs in the domestic environment (44%) and 71% are female. The environment built in accessible conditions allows the physically disabled person to obtain greater autonomy in their ambulation, and consequently in their activities.

In Brazil, NBR 9050:2020 establishes criteria and parameters for built environments, regarding accessibility conditions. Among the elements that enable accessibility are grab bars, which are necessary to guarantee the use of toilets, bathrooms and changing rooms, safely and autonomously by People with Disabilities (NBR 9050, 2020).

Grab bars in toilets, showers and changing rooms are fixed to the wall and floor, as the standard establishes, however, this is not the case when it comes to private and domestic environments. There are few domestic places where fixed bars are installed, which makes it difficult for people with disabilities to occupy these spaces. With the aim of enabling accessibility in places where there is none, the universal portable grab bar appears. Because it is portable, the user can take it when traveling, when visiting someone or even when renting a property for a period of time and it is not possible to modify it permanently. In the context of the COVID-19 pandemic, there was a 20% increase in sales of products such as: grab bars, bathroom alarms, impact plates, among others (OVALE, 2020).

An important aspect of any assistive device is the user experience, which can be provided with the appropriate implementation of usability principles. Shields (2004) argues that approximately 70% of the elderly wheelchair users studied require assistance with basic self-care activities, mainly in relation to bathing, toileting and dressing.

Based on studies by different authors such as: Xiang (2006), Chen (2011), Brechtelsbauer and Louie (1999) and Tsai (2020), with a view to falls in PwDs. This research aims to evaluate the use of a universal portable grab bar. The product evaluation was carried out by two people with disabilities, through a predefined task, and a subsequent questionnaire on the 10 Usability Principles proposed by Jordan (1998).

METHOD

An applied study was carried out with a qualitative approach, in relation to its objectives, it is classified as exploratory and descriptive. From the point of view of technical procedures, a data survey was carried out among users (SILVA; MENEZES, 2005; GIL, 2008). The methodology was divided into two phases, the first of a theoretical nature, where research was carried out on the main themes for theoretical support and the second practical phase with Applied Research (Figure 1).

Figure 1. Divided Methodology of the Study.
Source: Prepared by the authors (2021).

The Reference Blocks: Product, User and Context (MERINO, 2016) were used to organize the information collected, as they enable the definition of techniques and tools to be used during the development of the study.

Product Use Procedure

The product to carry out the evaluation was chosen because it is commercial and allows it to be fixed to different surfaces, without suffering deformation when used. Regarding the Context, it was defined that the tasks would be carried out in bathrooms, one residential and the other public, both located in the city of Caxias do Sul (RS).
Initially, the TCLE and TCUIV were read and signed, as per instructions in Resolution of the National Health Council (CNS) No. 466 (BRASIL, 2013). Next, photographic records of the context were taken and, with the help of Kinovea software, users' anthropometric measurements were investigated.
Next, the activity script was described (Figure 2) and users were asked to perform the first two tasks once, and the last four tasks five consecutive times with an interval of 5 seconds:

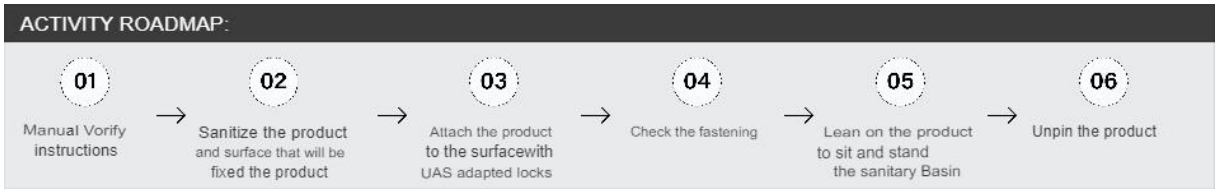

Figure 2. Activity Script.
Source: Prepared by the authors (2021).

After carrying out the tasks, questionnaires relating to the usability of the Product were applied, containing 10 questions (one question for each principle) relating to the 10 principles of Usability (Jordan, 1998), with response options on a Likert Scale, depending on the degree of agreement or disagreement on the question by selecting a point on a scale with five gradations, being: fully satisfied, partially satisfied, neutral, partially dissatisfied, totally dissatisfied (Figure 3).

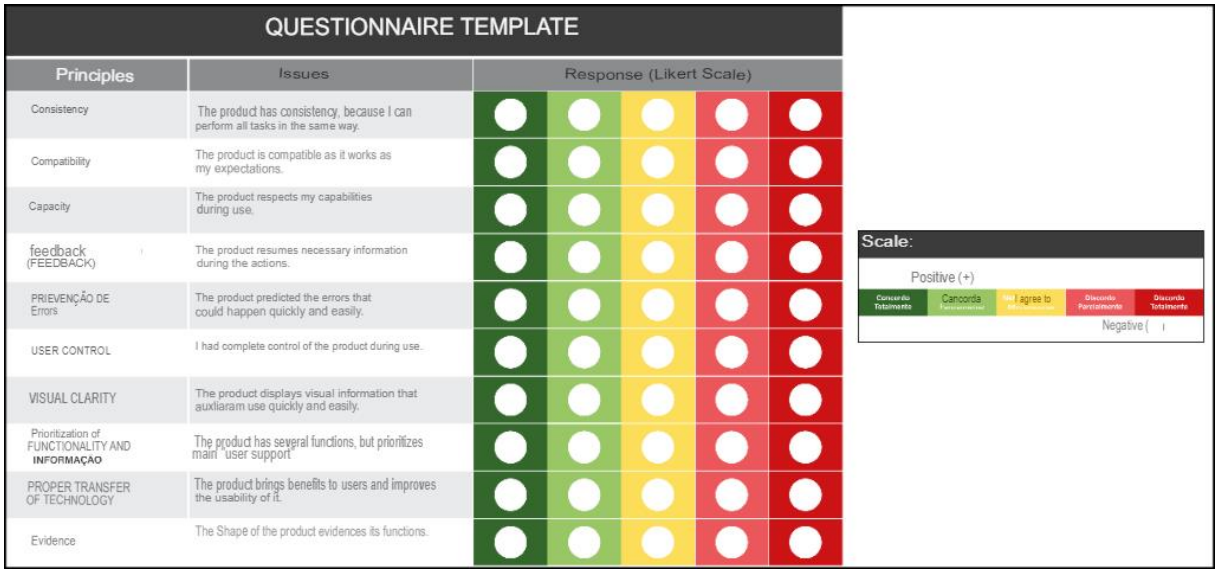

Figure 3. Questionnaires regarding the usability of the Product.
Source: Prepared by the authors (2021), adapted from Jordan (1998).

The data was organized in an Excel 2019 spreadsheet and the average time spent using the portable bar by the two users was identified. The activity was timed with the aid of a hand-held digital stopwatch from the brand Anytime, with the aim of marking the interval between tasks and evaluating the execution time of getting up from the toilet bowl five times and checking the durability time of fixing the toilet. product on the different surfaces of bathrooms, 8mm thick tempered glass and ceramics. Finally, Project Requirements were proposed, divided into the User Product and Context reference blocks, taking as a reference the analysis of user evaluation results.

MATERIALS AND EQUIPMENT

In this study, various materials and equipment were used. Figure 4 presents a temporal diagram of the activities.

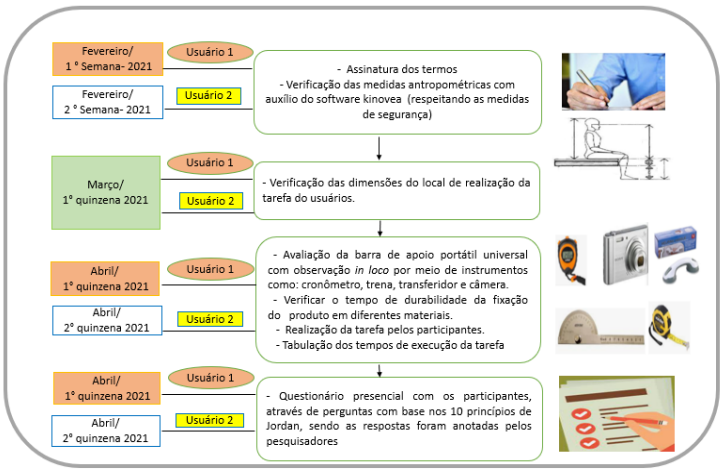

Figure 4. Temporal Diagram of Activities.
Source: Prepared by the authors (2021).

PHASE 1 – THEORETICAL (Theoretical Support)

In the first stage, we sought to understand the current scenario of Persons with Disabilities (PwD), Assistive Technology, Usability.

Person with Disabilities (PwD)

The term Person with Disabilities (PwD) was recommended in June 1994 by the Salamanca Declaration and Line of Action, during the World Conference on Special Educational Needs: Access and Quality (UNESCO, 1994). In the International classification of functioning* (ICF), disability and health, disability was defined as a limitation in a functional domain that arises from the interaction between a person's particular capacity and environmental and personal factors (WHO, 2001).

On December 2, 2004, through Decree 5,296, the federal government categorized the types of disability into five, being: (i) physical disability: complete or partial alteration of one or more segments of the human body, resulting in impairment of function physical; (ii) hearing impairment: bilateral, partial or total loss of forty-one decibels (dB) or more, measured by audiogram at frequencies of 500Hz, 1,000Hz, 2,000Hz and 3,000Hz; (iii) visual impairment: blindness, low vision, cases in which the sum of the visual field measurement in both eyes is equal to or less than 60° or the simultaneous occurrence of any of the previous conditions; (iv) mental disability: intellectual functioning significantly below average, with manifestation before the age of eighteen and limitations associated with two or more areas of adaptive skills; (v) multiple disabilities - association of two or more disabilities. Furthermore, the decree considers People with Reduced Mobility to be all those who do not fit into the previous types, and who have, for any reason, difficulty moving, whether permanent or temporary, generating an effective reduction in mobility, flexibility, motor coordination and perception. (BRAZIL, 2004).

According to the survey carried out by the Brazilian Institute of Geography and Statistics (IBGE), in the 2010 demographic census, approximately 46 million people living in Brazil declared to have some disability (23.9%), being classified as: visual, auditory, motor and mental or intellectual. In this scenario, of the 23.9%, it was detected that approximately 7% have motor disabilities, with different degrees of difficulty, and of these 2.33% were severely affected. In the South of the country (Santa Catarina, Paraná and Rio Grande do Sul), it is estimated that

22.51% of the population has some disability and of these, 7.11% are related to motor disability (BRASIL, 2012; IBGE, 2019).

The World Health Organization (WHO) in June 2011 launched the World Report on Disability, which recognizes disability as the result of the interaction between PwD and behavioral and environmental barriers that prevent their full and effective participation in society on an equal basis. Furthermore, the report proposes recommendations for policies and programs at national and international levels, through measures to improve the quality of accessibility and equal opportunities, promote participation and inclusion, and enhance respect for the autonomy and dignity of PwD (WHO , 2011).

In the Brazilian scenario, the Brazilian Law on the Inclusion of Persons with Disabilities/ Statute of Persons with Disabilities (Law No. 13,146/2015) came into force on July 6, 2015, with the objective of ensuring and promoting, under equal conditions, the exercise of rights and fundamental freedoms for PwD, aiming at their social inclusion, and considered PwD to be anyone who has long-term impairments, whether of a physical, mental, intellectual or sensory nature, which, in interaction with one or more barriers, can obstruct their full and effective participation in society on equal terms with other people. The second chapter of the law states that every PwD has the right to equal opportunities with other people and that they will not suffer any type of discrimination, and that it is the duty of the State, societies and families to ensure, with priority, the realization of rights referring to life, fatherhood or motherhood, health, rehabilitation, scientific and technological advances (BRASIL, 2015).

Assistive Technology (AT)

The WHO (2001) understands Assistive Technology (AT) as any product, instrument, equipment or technology adapted or specially designed to improve the functioning of a PwD (WHO, 2001). Legislation (Law 108-364-OCT. 25, 2004) of the United States of America (USA) defines TA as any item, piece of equipment, or product system purchased commercially off the shelf, modified, or customized that is used to increase, maintain or improve the functional capabilities of individuals with disabilities.

The Technical Assistance Committee (CAT) was established by Decree No. 5,296/2004 within the scope of the Special Secretariat for Human Rights of the Presidency of the Republic, with the aim of simultaneously improving, providing transparency and legitimacy to the development of Assistive Technology in Brazil (BRAZIL, 2004). AT is understood as an area of knowledge, with an interdisciplinary characteristic, which encompasses products, resources, methodologies, strategies, practices and services that aim to promote the functionality, related to activity and participation, of people with disabilities, disabilities or reduced mobility, aiming to their autonomy, independence, quality of life and social inclusion (CAT, 2009, p.9).

Bersch (2009), defined AT, as the application of knowledge in the service of solving functional problems for people with disabilities, and which aims to break down the external barriers that prevent the action and participation of people with some type of limitation. For Prestes (2011), TA is used to define a huge diversity of resources and services aimed at PwDs and these users require specialized services from different areas to facilitate their inclusion in the most varied social activities. According to Law No. 13,146/2015, TA was defined as any and all products, equipment, devices, resources, methodologies, strategies, practices and services that aim to promote functionality, related to the activity and participation of people with disabilities. or with reduced mobility, with a view to their autonomy, independence, quality of life and social inclusion (BRASIL, 2015). The European Parliamentary Research Service (EPRS) reports that ATs are designed to improve the functional capabilities of PwD, some relatively low-tech, such as reading glasses, crutches and hearing aids, and others more advanced, using cutting-edge science and technology (NIERLING,2018).

Regarding the types of AT, the ISO 9,999:2011 standard establishes terminologies and a classification of assistive products for PwD, divided into three decreasing levels: class, subclass and detail.

The Ministry of Finance, Science, Technology and Innovation and the National Secretariat of Human Rights of the Presidency of the Republic, in the publication of Interministerial Ordinance No. 362, of October 24, 2012, in the first annex, referring to the TA categories that do not require recommendation from a health professional, divided them into 12 Macro Areas, together with a description, and the Code, resource (goods and services) and description of the resource, being: (i) aids for daily life and practical life; (ii) Augmentative and Alternative Communication (AAC); (iii) computer accessibility features; (iv) Environmental control systems; (v) architectural projects for accessibility; (vi) orthoses and prosthetics; (vii) postural adequacy; (viii) mobility aids; (ix) aids for visual ability qualification and resources that expand information to people with low vision or blind people; (x) aid to increase hearing ability and autonomy in communication for people with hearing loss, deafness and deaf-blindness; (xi) vehicle adaptations; and, (xii) sport and leisure (BRASIL, 2012).

In relation to the first category in the area of aid for daily life and practical life, stands out are supports for household items, clothes designed to facilitate dressing and undressing, button fasteners, velcro, transfer resources and support bars (BERSCH,2017) . The bar is considered a product that aims to provide safety to people, especially in bathrooms in general, being made of aluminum with epoxy painting and must support more than 150kg, with a secure fixation (NBR9050:2020).

Usability

According to ISO 9241-11 (1998), usability is defined as the ability of a product to be used by specific users to achieve specific objectives with effectiveness, efficiency and satisfaction in a specific context of use.

It is known that design seeks to understand people's needs, with the aim of designing and adapting products to their needs, providing more comfort during use (MORAES, MONT'ALVÃO, 2010). Iida (2005), describes that the comfort of a product must be extremely analyzed during the development of a project so that it best meets the user's needs, without and with some type of limitation.

According to Jordan (1998), the analysis of how complex a real task is when carried out is based on the number of steps needed to complete it: the fewer steps, the more simplified the task. Task analysis can be used to develop predictions about: ease of performing a given task; difficulty in performing a certain task; and, degree of effort required to reach the end of the task.

In this sense, Jordan (1998) proposed 10 usability principles, which designers/engineers can take as references, when developing products to obtain more satisfactory results, these principles are in Figure 5.

USABILITY-JORDAN (2008)					
	Principle	Justification		Principle	Justification
01	Consistency	It means that similar tasks should be performed in the same way.	06	user control	Users should have as much control as possible over the interactions they have with the product.
02	Compatibility	The way the compatible product works should correspond to the expectation of the user, created from lived experiences.	07	VISUAL CLARITY	Dave information to be made available in a manner that can be read in a quick and easy, without causing confusion.
03	Capacity	The user has certain capabilities for each role that must be respected. It is important that when using a product, it does not have its capabilities deleted or outdated.	08	prioritization of FUNCTIONALITY AND Information	Products with a wide range of functions should be appropriate to prioritize some of these functions when designing the product interface. The products must be accessible and easy operation
04	Feedback (FEEDBACK)	It is important that product interfaces return information to users on the result of any action taken by them.	09	PROPER TRANSFER OF TECHNOLOGY	The assimilation of technologies developed for other areas can potentially bring benefits to users and their possible consequences and problems to enhance the usability of the product.
05	PREVENTION OF Errors	Products should be designed in such a way that the possibility of occurrence of errors are minimized and the user can correct any errors in a timely manner. quick and easy.	10	Evidence	The formal solution of the product must clearly indicate its function and the mode of operation.

Figure 5. Ten usability principles.
Source: Prepared by the authors, adapted from Jordan (1998).

This bibliographical research enables an understanding of the concept of people with disabilities. By analyzing the user's limitations, it is possible to identify which specific Assistive Technology product will contribute to its better usability. The possibility of evaluating the product, taking into account usability, allows improvements and corrections, and Jordan's principles (1998) corroborate this.

PHASE 2 – PRACTICE (Applied Research)

To evaluate the Product (Figure 6), the 2MED brand portable support bar was used, as it is widely used and has a low purchase price, approximately R$ 60.00. The bar in question is predominantly made of PVC material (Polyvinyl Chloride), has two suction cups (A), responsible for fixing the portable bar, has a mass of 284 g, and a dimension of 290 mm x 80 mm, two springs in stainless steel (B) and rubber pins (C). It also has two locks for the suction cups to operate and its structure is built in parts: upper (E) and lower (F).

Figure 6. Portable Grab Bar.

Source: Adapted from YSL Moments (2021).

Two Users who are PwDs were considered, User I is a 61-year-old female, with osteoporosis problems and difficulty moving due to falls, and User II is a 60-year-old male, who has a motor disability. , being a user of a motorized wheelchair (Figure 7). Regarding the second user, it is known that he became disabled at the age of two due to infantile paralysis, which caused limited development of the lower limbs, resulting in the limbs not being able to articulate, keeping them always straight.

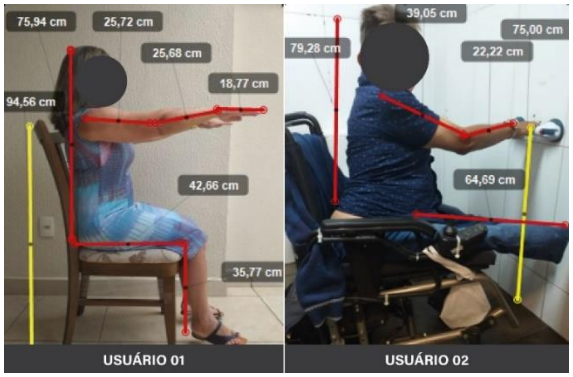

Figure 7. Users and their anthropometric measurements.
Source: Prepared by the authors (2021).

Using the Kinovea software, it was possible to extract anthropometric measurements, as shown in Table 1, (without the need for physical contact, as the collection period coincided with the COVID-19 Pandemic), with the reference measurements highlighted in yellow in the previous figure. The height declared by user I was 156 cm while user II was unable to inform how tall he was.

Table 1. Anthropometric measurements of users

Item	**User I**	**User II**	**Unid.**
Height	154,37	143,78	cm
Hand Size	16	15,50	cm
Arm Size	25,68	34,42	cm
Forearm Size	25,72	22,17	cm
Leg Size	78,40	64,69	cm
Pasta	60,00	46,00	kg

Source: Prepared by the authors (2021).

The width dimensions measured with a measuring tape of 70 and 156 cm at the evaluation sites were taken as a reference when using the Kinovea software. A dimensional discrepancy was observed between the two locations, while user I performed in a space with a toilet area dimension of 70 x 139 cm, user II used in a space with dimensions of 156 x 160 cm, it is highlighted that the bathroom floor shown in Figure 8a is made of white porcelain tiles and has a lower moisture absorption rate, making the floor less slippery.

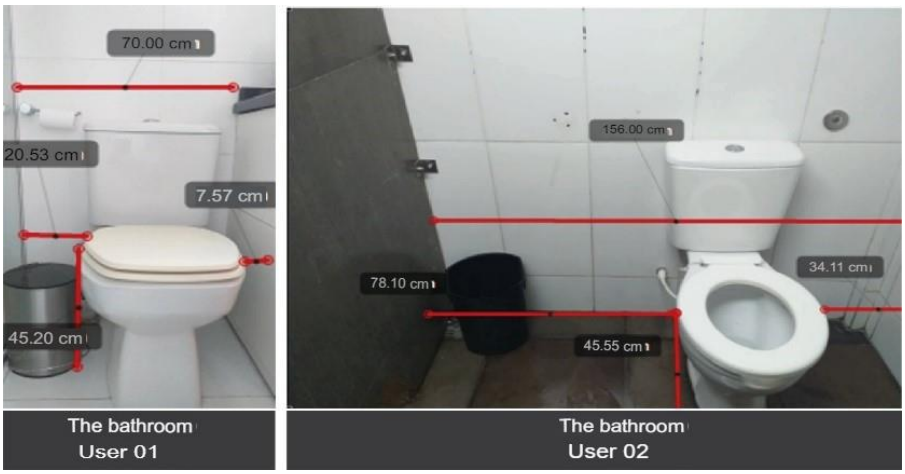

Figure 8. Home bathroom of User 1 (8a) and public bathroom used by User 2 (8b).

Source: Prepared by the authors (2021).

In relation to the second bathroom (Figure 8b), it was identified that its slate floor is slippery when wet, together with the absence of fixed support bars, which can cause inconvenience to users. It was found that the size of the toilet area is in accordance with NBR 9050, enabling diagonal, perpendicular and lateral transfer. The washbasin was inserted on the lower right side of figure 5b, it is at a height of 85 cm and a length of 35 cm, exceeding the height of 80 cm recommended by the NBR9050 standard.

Based on this information, in addition to the data obtained through Theoretical Support (Phase 1), and considering the instructions suggested by Merino (2016), in which he says that a DCU project must start from the Reference Blocks (PUC) , these were defined as follows:

- Product - Universal portable grab bar;
- User - People with Physical Disabilities;
- Context - Bathrooms, specifically the use of the toilet.

From the definition of the Reference Blocks, an on-site test was carried out with users, with the purpose of collecting as much data as possible and relevant for the development of the project, considering the real needs of the User, in accordance with reality of the product, the context in which it will be inserted, and consistent with the findings in the literature.

EXECUTION OF TASKS

After reading the consent terms (TCLE and TCUIV) and the description of the tasks to be performed, User I began the activity by checking the instruction manual contained on the box print, where the necessary amount of information for use was observed. of the product's main functions. Next, he cleaned the product and the surface to which it was fixed, then positioned the product on the surface, and then fixed it by positioning the locks in a diagonal position, a position of greater comfort and safety.

The Product was positioned on the right side of User I at a height of 75 cm and 45° inclination, and fixed to the surface of the shower glass, for a period of 40 minutes. We tried to fix it on the left side, but the portable bar did not fix it on the MDF in the bathroom sink cabinet. Furthermore, due to the distance between the toilet and the front wall, it was not possible to fix the bar to the wall, as the User had short reach.

After carrying out the surveys, the User used both hands, unfastened the product's suction cups, removing the locks. At first, the User did not realize that to effectively unfasten it, they must pull the spare end of the suction cup, as depending on the surface there is a higher level of fixation (Figure 9).

Figure 9. User Assessment I.
Source: Prepared by the authors (2021).

User II started by checking the instruction manual printed on the product box, where there was less adequate and necessary information for the correct use of the product. Subsequently, the product and the surface to which it was fixed were cleaned.
He used his dominant (right) hand and tried to position the bar on the right side of the toilet, but was unsuccessful, as the bar did not fit into the bathroom partition, made of granite stone. In a new attempt, it was possible to fix the bar on the bathroom ceramics for approximately 16 minutes, during which time it was possible to observe the reach of his arm in relation to the bar fixed in front of him, he used his right hand for five consecutive times, with a movement of the spine of approximately 60°, verifying the effective fixation of the bar. Based on the User's experience, a maximum reach distance of 60 cm was determined, at which the portable bar could be fixed in front of it, as shown in Figure 10.

Figure 10. User Assessment II.
Source: Prepared by the authors (2021).

User 2 identified that he did not have sufficient balance and reliability, due to the absence of part of his lower limbs when transitioning from the wheelchair to the toilet, making the use of this product unfeasible, and as a result, it was not possible to carry out the seated lift test in the private room. It was found that the product was easily unfastened after removing the external locks allocated by the authors.

TASK EVALUATION

To evaluate the Usability of the portable bar, the Structured Questionnaire technique was used, based on Jordan's questionnaire (1998). To answer the questions, the User chose an option on the Likert Scale, depending on the degree of agreement or disagreement on the question, choosing a point on a scale with five gradations, being: fully satisfied, partially satisfied, neutral, partially dissatisfied and totally dissatisfied. Then with the justification for each of the ten principles of the questionnaire. In figure 11, you can see the answers chosen by users, as well as a brief description of the justification reported.

Id.	Principle	User 01		User 02	
		Response	Justification	Response	Justification
01	Consistency	Agree Partially	The use of the product is similar to the use of similar, but their dimensioning causes distrust.	Agreed Totally	User expectations are met
02	Compatibility	Disagree Partially	The use of external locks that are not inserted in the product, caused inconsistency regarding the use of the product.	Disagree Partially	Did not feel safe about the suction cup latches.
03	Capacity	Agreed Totally	It works in a way compatible with the needs of the Product.	Agreed Totally	Lack of user balance in the use of the product simultaneously with the wheelchair.
04	FEEDBACK	Agreed Partially	There is no information related to the defixation of the ventodes of the product.	Agreed Partially	There are no open/closed descriptors in the product lock.
05	PREVENTION OF Errors	Disagree Partially	There is a possibility of errors in fixing to surfaces partially adherent.	Disagree Partially	There is no locking feedback from the suction cups.
06	CONTROL OF User	Agreed Partially	Due to the locking of the product, it should always be used two hands for your installation.	Agreed Partially	The beams may lose their fixation without the product offset from the surface.
07	VISUAL CLARITY	Agreed Partially	The idoma used in the packaging manual it made it impossible to read.	Agreed Partially	The idoma used (inglis) in the packaging manual, made it impossible its reading, and resulted in the failure of use on the first attempt.
08	Prioritization of FUNCTIONALITY AND INFORMATION	Agreed Partially	The product is easy to use after your understanding.	Agreed Totally	Fixing function imposed, through external latches.
09	Transfer Proper technology	Agreed Totally	The use of the suction system in similar products, with greater scaling, it can facilitate ADLs.	Agreed Partially	Use of few suction cups.
10	Evidence	Agreed Totally	Initially, the functional purpose of the Product.	Agreed Totally	Need to check which surface the product will fix.

Figure 11. Questionnaire 10 Jordan Principles - Users.
Source: Prepared by the authors (2021).

The responses demonstrated that the first considered two unsatisfactory principles, as they did not meet the needs of use, these being: Compatibility (02) and Error Prevention (05). Five principles were partially met: Consistency (01), Feedback (04), User control (06), Prioritization of functionality and information (08) and Evidence (10). Regarding those that meet needs, three principles were identified: Capacity (03), Visual clarity (07) and Adequate technology transfer (09).

In relation to the second User, the result demonstrated that three principles do not meet the usage needs, namely: Compatibility (02), Error Prevention (05) and Visual Clarity (07). Six principles were partially met: Capacity (03), Feedback (04), User control (06), Prioritization of functionality and information (08), Adequate technology transfer (09) and Evidence (10). Regarding those that meet needs, only one principle was identified, Consistency (01).

The non-service responses reported in relation to compatibility and error prevention show that expectations regarding the product's functioning were low, due to the fixing time and the obligation to insert locks. The manual written in English hindered the understanding of the product and this influenced the safety in using the product, as it did not provide visual feedback to check the fixation.

The problem that stood out, as it was noticed by both, was the apparent lack of security. Regarding this, User I reported that "there is a possibility of errors in fixing on partially adherent surfaces" and User II that "he did not feel secure in relation to the suction cup locks". To reduce this problem, some modifications were proposed, such as: emitting a light or sound signal to identify when it is fixed to the surface and demonstrating, with visual and tactile resources, when the suction cup vacuum is releasing.

In the evaluation of both, 6 principles were classified as "partially met". For User II, one of these was capacity, as there was a lack of balance when using the product, simultaneously with the wheelchair. According to NBR 9050:2020, for the use of grab bars by a wheelchair user to be possible, two bars must be installed on the side wall, one positioned horizontally and the other vertically, in addition to a horizontal bar on the back wall. bottom, thus ensuring greater safety for use. The User pointed out the lack of information about the usefulness of the product, especially at the time of installation and uninstallation.

Users proposed some modifications to the product, such as the use of a single suction cup activation system, having greater visual prominence at the location of activation, the use of a light and sound signal to identify when the product is correctly fixed to the surface and being contained in packaging with information in Portuguese, explaining how to install, use and uninstall.

Finally, based on the results of the evaluations and justifications, a list of Project Requirements was created (Figure 12) divided into Reference Blocks (Product, User and Context), which will serve as a basis for similar future projects.

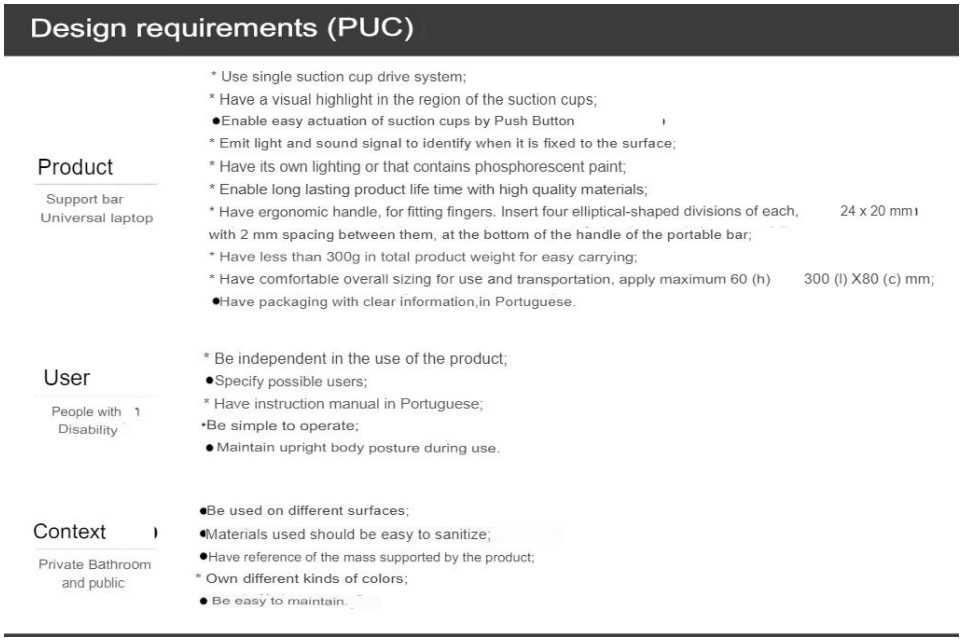

Figure 12. Product, User and Context Design Requirements.
Source: Prepared by the authors (2021).

CONCLUSION

The study focused on the use of the portable grab bar, specifically during the task of sitting on and getting up from the toilet. Through the usability assessment, it was possible to identify that insecurity in use was a problem perceived by both users and that, in addition, the product has barriers in its usability, due to a lack of clarity on how to use it correctly.

From the activity carried out by the two users, it was observed that they both had no experience with the product, highlighting the importance of Jordan's principles in helping users evaluate the product. It can be observed that, although the product is intended to provide greater safety to users, they reported situations in which the product did not meet their expectations, resulting in possible non-use.

In the available literature, there are no studies carried out focusing on portable grab bars, only with fixed models, so it was not possible to make a critical comparison with previous works. This fact highlights the importance of the scientific contribution of this work, which evaluated and proposed improvements for an Assistive Technology with great potential for use that, until then, had not been evaluated with a user-centered methodology.

This study presented results from a usability evaluation of a portable grab bar, with improvement proposals divided into three blocks. It is intended in future articles to present a product model with the modifications highlighted in the results, with the aim of meeting most of Jordan's principles in a new user evaluation.

Due to the pandemic period in which this study was carried out, there was no possibility of carrying out the usability test with more users, which would consequently help researchers see more patterns in the responses. In any case, the participation of two users with very different characteristics and also in different contexts made it possible to have greater security in the scope of the evaluation.

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