Rehabilitation and Product Design: Towards the Inclusion of People with Disabilities through Interdisciplinary Collaboration

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Abstract. In low-GDP countries, such as Brazil, many older people and people with disabilities rely on the public health system for access to assistive devices, which are important to support them to live healthy and dignified lives. However, many problems limit their access to specialized prescriptions and appropriate devices that satisfy their needs and expectations. This paper explores the challenges, contributions and results from an interdisciplinary collaboration between two different yet related areas of knowledge – Product Design and Rehabilitation – in education, research and innovation in assistive technologies. The combination of product design education and rehabilitation services has mutual benefits from the perspective of research and innovation, thus contributing for the community. Here, we report on the process and benefits resulting from four years of interdisciplinary collaboration on assistive products for the aging population and people with disabilities.

Keywords: Assistive Technologies, Product Design, Rehabilitation.

1 Introduction

The World Health Organization (WHO) estimates that one billion people in the world experience disability [1]. While there have been important achievements towards the promotion of access for rehabilitation services and technologies, still there are several problems that, ultimately, limit people with disabilities of having equal opportunities and living dignified lives.

Recent WHO guidelines on promoting inclusion of people with disabilities emphasize improving the variety and quality of products supporting people's independence and quality of life. A list of the 50 most prioritized assistive devices for promoting inclusion and allowing a healthy, productive and dignified life has been proposed [2]. The list highlights the importance of providing the users access to more diverse, better quality and customable assistive devices, as well as to specialized prescription, maintenance and follow-up.

Most of the Brazilian population rely on the public health system for rehabilitation and assistive technology services. Data from the SORRI BAURU Rehabilitation Center reveals that most of the assistive devices are provided via the public health system [3]. It has been pointed out that the AT product list provided by the Brazilian government is restricted in terms of the variety of the products and the costs supported for each device. As a result, those who depend on the public system to acquire an assistive device will have limited options and, most of the times, will not receive the most appropriate device for their specific needs.

The design of products for people with disabilities have unique characteristics, requiring skills and a new understanding of what it means to be human [4]. The interaction between the user and the assistive device transcends the context of only practical issues, as the significance of such products have also been related to acceptance and stigma issues [5].

Disability and personal identity are closely linked. Thus, a disability is a human condition that cannot be addressed by technology alone; form and function are equally important. An assistive device should meet the users' needs while supporting personal expression. Assistive technology that works satisfactorily but leaves its user feeling diminished is a failure. Taking a holistic approach when addressing assistive technologies is therefore important [4].

In low-GDP countries, demographic data reveals the tendency of an ageing society, which is already established in high-GDP nations. The ageing process affect people's physical, sensorial and cognitive abilities, leading to functional difficulties in many activities of daily life. Therefore, living longer brings together the challenge of maintaining independence, social participation and quality of life. An integrated and interdisciplinary-based approach on health, rehabilitation and technology is perhaps the strategy most likely to have success on promoting independence and quality of life for the wide range of people who will experience disability.

From a pedagogical perspective, developing students' empathy for the needs of people with disabilities, as well as sensitivity for the need of a holistic approach to assistive technology design has been a challenging but necessary target in Design education. This paper presents the framework of an interdisciplinary approach in the areas of Product Design and Rehabilitation towards the improvement of Assistive Technology research and development.

2 Interdisciplinarity in Assistive Technologies

When addressing complex problems from the perspective of the specificities and individualities of each discipline, it might be difficult to figure out how to connect into practical approaches and sciences from different areas of knowledge. A full view of the situation may reveal the potential of such areas in complementing each other, fulfilling gaps and empowering education, research and innovation.

Product Design education addresses a variety of issues that are organized in thematic axes mostly related to technology, humanity, science and expression. While exploring human characteristics and needs is well addressed in disciplines such as Ergonomics,

Human-Computer Interaction, among others, Product Design students often lack knowledge about health sciences related to people with disabilities. For example: to design a wheelchair for individuals with paraplegia, knowing that there is an impairment in the lower limbs movement is not enough to have a full picture of all the related issues, characteristics and needs of the users. Therefore, health sciences represent important knowledge about how to properly design assistive technologies and products for independent living.

On the other hand, rehabilitation professionals are very effective in – among many other skills - detecting what the patient really needs and, many times, they recognize the features that a product must have to best meet the patients' needs. However, health and rehabilitation professionals are not trained and familiar with how to design and make a prototype, especially in industrial levels, even though physical and occupational therapists, among other rehabilitation professionals, have the skills to make customized devices, tools and adaptations to benefit the users' independence in daily activities.

An important contribution for the comprehension of the complexity and multi-factorial characteristic of the challenges for the inclusion of the people with disabilities was provided by the International Classification of Functioning, Disability and Health (ICF), established in 2001 as the WHO framework for describing and measuring health and disability [6]. This holistic approach substitutes the negative focus of the disability by a positive perspective focused on the users' potentials. According to the ICF model, people's functionality and limitations are determined by the environmental contexts [7], and the assistive devices work as facilitators - improving independence and autonomy – for the activities of daily living (ADL). This holistic view provides a common platform for the interdisciplinary collaboration between Design, Rehabilitation and related areas, emphasizing the need of considering not only the disability itself, but also people's characteristics, needs and potentials, integrated with environmental context (Fig. 1).

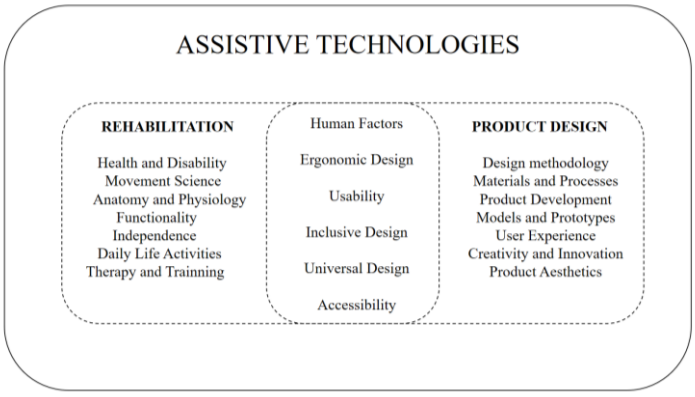

Fig. 1. Specific and shared knowledge: Design and Rehabilitation based collaboration on Assistive Technologies.

3 Product Design and Rehabilitation: Education, Research and Innovation

The collaboration between Product Design (PD) at UNESP and SORRI BAURU Rehabilitation Center was built up based on the mutual understanding that only an interdisciplinary-based approach would meet the needs and fill gaps from each specific area: design and rehabilitation. From the academic side of PD, there was a consensus that theoretical classes did not provide a complete understanding of the users' characteristics, needs and expectations, and that this knowledge is essential for the design of products for people with disabilities. From the perspective of SORRI rehabilitation professionals, the challenge was to apply practical observations and the experience with the user into a reproducible and replicable design process. Combining rapid prototyping technologies with customized orthotic/prosthetic process was also a recognized challenge for the rehabilitation approach.

The interdisciplinary collaboration between SORRI and Product Design School at UNESP was based on an integrated structure of three main axes: Education, Research and Innovation (Fig. 2).

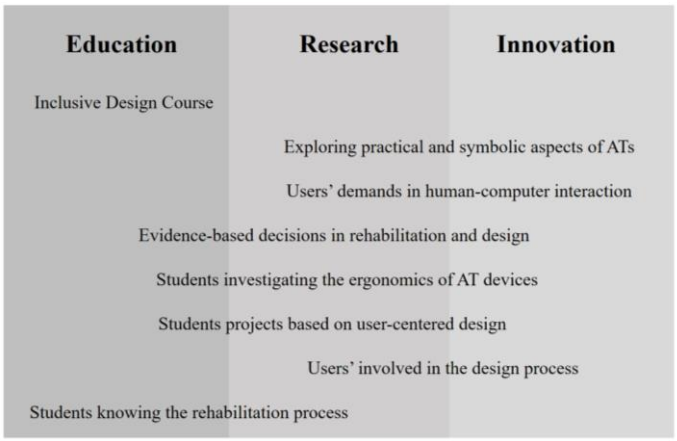

Fig. 2. UNESP Product Design and SORRI Rehabilitation: initiatives on interdisciplinary collaboration.

Assistive Technology Research and Development initiatives have focused on improving users' independence, satisfaction and quality of life. In the context of wheelchair mobility, the benefits of practicing adapted sports [8], as well the implementation of power assistance in manual wheelchairs [9, 10], handrim design [11] and the influence of axle position and the use of accessories on manual propulsion biomechanics [12, 13] have been reported. Additionally, computer usage by people with tetraplegia [14] and text entry optimization [15, 16] have also been addressed. A research and innovation-based study described the involvement of the users' in the process of designing a new walker as assistive mobility device for children with cerebral palsy [17]. The

challenges and opportunities of the mobility aids for the elderly have been discussed in the context of the Brazilian market [18].

Parallel to the research studies, initiatives on education in the scope of Rehabilitation and Product Design were taken. At UNESP, a new course was proposed for the Bachelor Program of Design, named “Inclusive Design”, aiming to provide the students a view on the many aspects related to disability, social inclusion, accessibility and assistive technologies, and how this knowledge can be implemented in the design process from the perspective of inclusivity. In this course, the students are encouraged to center the design process in the user, exploring their characteristics, needs, expectations, to design proposals with the aim of enhancing function, independence, social participation and quality of life. In this course, the students’ work in group in the development of solutions based on the demands from SORRI, which has strengthened the students’ engagement on the project. Students’ visit to SORRI Center, lectures gave by SORRI staff and the contact with the SORRI rehabilitation team, patients, families and caregivers were experiences provided to support the students during the Inclusive Design course. Additionally, innovation has been an important target of the UNESP-SORRI collaboration. From the research-education platform, innovation-based projects have been carried out, resulting in Product Design bachelor’s final projects. Working together with SORRI staff and other health and rehabilitation institutions from Bauru city, UNESP students have developed projects based on patients’ needs and expectations, such as: customized upper limb prosthesis made prototyped with 3D printing, jewelry-look (ring) orthosis for fingers deformity due to rheumatoid arthritis), multisensorial experience toy, mobile sink for institutionalized elderly and tableware kit for elderly people with motor difficulties on the hands (Fig. 3).

Fig. 3. Product Design students’ projects based on exploring, designing and testing with subjects. Reproduced with kind permission by Aline Darc P. dos Santos, Beatriz Martino Matos and Ana Elisa Franchini.

4 Conclusion

The contributions of a fruitful collaboration between Product Design and Rehabilitation are explored herein. The integrated platform based on education-research-innovation inspired the academics from Computer Science and Product Design at Oslo Metropolitan University (OsloMet, Norway) and Product Design at UNESP in proposing an international collaboration on Assistive Technologies and Products for Independent Living. In January 2017, the 4-years project "Collaborative Design and Rapid Prototyping of Assistive Technologies and Products for Independent Living" (SIU – Norwegian Centre for International Cooperation in Education, Project Number UTF-2016-long-ter/10053) started, which has SORRI BAURU as a partner. The aims, scope and strategies of the project have been previously described [19]. Educational, research and innovation initiatives from this project are being currently developed and will be reported in future studies.

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