

Adapting Inclusive Design Concepts in Developing Assistive Mobility Design System for PWDs Specific Community in Malaysia using Design Develop Research (DDR)

Ahmad Fairuz Ariff, Rahman. R, Zainol Fithri. ZS, Liping Qiu
University Putra Malaysia, Kolej Tingkatan Enam Petaling Jaya

To Link this Article: <http://dx.doi.org/10.6007/IJARBSS/v14-i5/21577>

DOI:10.6007/IJARBSS/v14-i5/21577

Published Date: 28 May 2024

Abstract

Many current design development processes include design concepts for users, but there is still room for improvement and time for design concepts to be executed, thoroughly researched, and altered to be significant throughout the product development stages. The role of Inclusive Design (IDA) is recognized as one of the significant alternatives to produced design such as an Assistive Mobility Design System (AMDS) to stimulate movement of persons with disabilities (PWDs), as well as to simplify their journey throughout the environment to cater everyday demands. This study aims to apply Design Development Research (DDR) approaches in order to further comprehend the consumers and specific items studied and observed. The data was gathered by 10 different wheelchair users and 5 experts, include designers, engineers, and society officers. This assignment's main data was effectively collected via Design Development Research (DDR) methodology instruments. The main study's goal is to develop an Assistive Mobility Design System (AMDS) for groups of persons with disabilities (PWDs), As knowledge contribution, this study will assist to develop a novel system for those with disabilities (PWDs) to enhance their quality of life for end users. It provides guidance for industrial designers, manufacturing engineers, and specific community to understand about Disable Product Design and users need and requirements.

Keyword: Inclusive Design, Assuasive Mobility Design System, PWDs, via Design Development Research (DDR)

Background of Study

The current Mobility Design System (MDS), which includes manual, motorized, and smart wheelchairs that meets the needs of People with Disabilities (PWDs), was found to be very expensive, bulky, uncomfortable, and not up to date in terms of safety, functionality, aesthetics, and ergonomics. This shows that the current design and development of MDS can still be developed and there are rooms of improvement. Testing for reliability is also important and validated for functionality, usability, and user satisfaction.



Figure 01- PWDs on wheelchair

Most of the PWDs in Malaysia are not financially able and not physically fit as Shafiq (2014) mentioned that PWDs require special treatment, special medication, support system, special food and other things. More money is needed to fulfil their need. Without help from the government agencies and other people, PWD most likely cannot survive in this competitive world. Furthermore, the lack of involvement in innovation management is particularly attributed to issues related to salary, compensation, career advancement, and reward management Yen (2022), Hence, the process and framework of inclusive design will therefore be used by the researcher in this research study that involves PWDs with wheelchair in Malaysia propose solutions for their difficulty faced to cater daily activity

Having engagement working with disable people for more than 5 years in various projects, has triggered the researcher to look into more specific areas involving design with wheelchair users in the local scenes. Those experience has provided the researcher with an idea to having in depth study for design involvement by engaging with the concept of 'inclusive design' to be part of developing a new concept for wheelchair users in Malaysia. This study aims to employ Design Development Research (DDR) into developing a novel wheelchair design for the use of local users in their own environment and comply with their requirements.

Problem Statement

Basically, there are two (2) main problem statement which has been identified within this research:

i.) The problem solving based, human and ergonomic factors

The absence of human and ergonomic factors in a non-responsive design results in an inability to integrate empathy into the design process. Most solutions in current product design are mass produced in order to meet the market demand, and the design is focused on style rather than problem solving, resulting in unsolved problems where the design does not incorporate human factors, ergonomics, and empathy. Current product design often prioritizes mass production and style over problem-solving, leading to a lack of consideration for human factors, ergonomics, and empathy (Lorentzen, 2018; Bruseberg, 2002)

In this case, some of ergonomic designed products are not catered specifically to the needs of PWDs (case by case) and need to be studied concurrently with the specific user to elicit significant results of products for a specific target user.

ii) Performing the manufacturing practices as opposed without emphasize the human factor within the design.

By using manufacturing methods rather than focusing on the human aspect of the design would not satisfy the end user. This is due to the decision making in design selection is done by a non-competent person due to the person's high ranking rather than decision making by a competent designer. According to Sala (2021) using human factors in design research necessitates by the designers considering and researching potential risks and hazards, as well as the physical, mental, and sensory capabilities and limits of the people who will use the product.

As a results, the need to study about human factors within the design, and incorporating to understand about specific user such as PWDs is a necessity to encourage the significant products for the disable community.

Research Questions

In this study, the researcher will list down the research questions of this research project (DDR) are:

- I. What is the characteristic of PWDs on wheelchairs and their daily activities?
- II. What are the difficulties faced by PWDs in maneuvering on wheelchair in their daily life activities?
- III. How to overcome difficulties faced by PWDs in maneuvering on wheelchair in their daily life activities?

Research Objectives

- i.) To identify definition and characteristic of PWDs using wheelchair
- ii) To analyze difficulties faced by PWDs on maneuvering on wheelchair in their daily life activities
- iii.) To propose a concept design, development and to validate a wheelchair with MDS for PWDs to overcome their difficulties on maneuvering on wheelchair in their daily life.

Literature Review

In this research, the literature review will be divided into three main subjects which are the PWDs using wheelchair, Mobility Design System (MDS) and Inclusive Design Concept (IDC). In this research study, the researcher will be using design push approach rather than technology-based design approach in conceptualizing the mobility design system for PWDs using wheelchair.

Assistive mobility Design system

As to enhancing Mobility for People with Disabilities through Assistive Technologies and Inclusive Design, Research has consistently highlighted the importance of assistive technologies and adaptive mobility design in physical and occupational therapy for people with disabilities. These technologies, such as prosthetic and orthotic devices, can significantly enhance mobility and independence (Domingo, 2013). However, there is a need for a more autonomy-based approach to the design of mobility assistive technologies, particularly for those with spinal cord injuries, to better meet individual needs (Khalili, 2018). The development of new categories of assistive technologies, such as the Active Powered

Wheelchair, can further improve the health and quality of life of people with disabilities (Luccarelli, 2019)

In addition, the use of electronic travel aids and the collaboration between rehabilitation professionals and clients are crucial in the evaluation and teaching of adaptive mobility techniques for physically handicapped blind individuals (Coleman, 1984)

Inclusive Design

Inclusive design is a user-centered approach that aims to accommodate a broad range of abilities within the user population (Mackay, 2016). It involves working with people to create products and services that meet the needs of the widest possible audience, regardless of age and ability (Tosi, 2023). This approach goes beyond physical and cognitive aspects of disability, considering people's lifestyles and values (Jordan, 2000). Inclusive design can lead to products that reach a wider market, improve customer satisfaction, and drive business success (Waller, 2015).

The aim of inclusive design is to make products that can be used by as many people as possible without making them feel bad about themselves or requiring them to use special tools or make adjustments.

In conjunction to this, there are three main component area to contribute in producing inclusive design-based product a illustrate below:

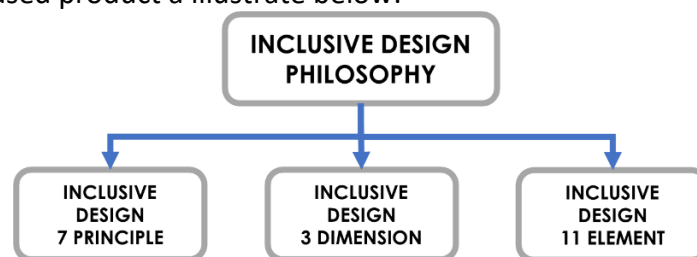


Figure 02 inclusive design component

As per above figure, inclusive design component within the inclusive design philosophy consists of inclusive design principle, inclusive design dimension and inclusive design element. Each of them is interrelated in producing inclusive based product design. as for design principle, The Seven Principles of Inclusive Design, which were created by Mace (1997), applies to environment, products, and communication. The Center for Universal Design at NCSU mentioned that the principles can be used to look at current designs, guide the design process, and teach designers and consumers how to make products and situations more accessible.

Overall, the design output employing the V model Inclusive Design is meaningful (as shown below) in terms of providing design input during the design process

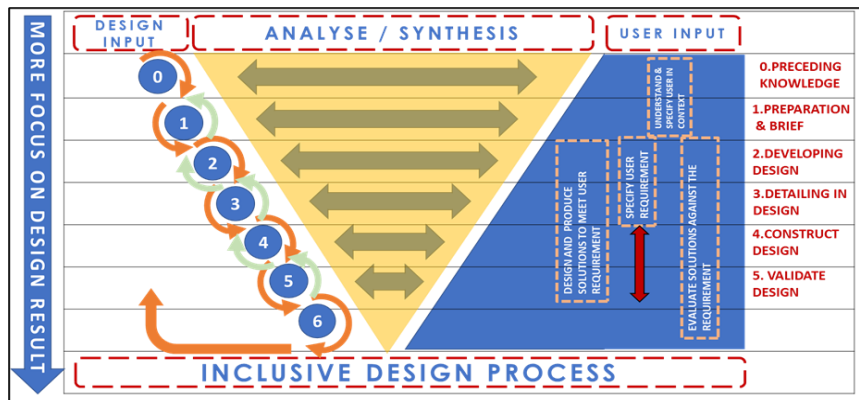


Figure 03 – V model Inclusive Design -The Design Process

Concept of Person with Disability (PWDs)

A disability is defined as any condition of a person’s body or mind that makes it more difficult for them to engage in activities, or interact with their surroundings. These disabilities can define as disability in terms vision, movement, thinking, remembering, learning, communicating, hearing, mental health, and social. (www.malaysia.gov.my). in his study, the researcher is focusing on disability in terms movement, which using wheelchair.

Research findings indicate that disability can be classified into two categories which is hidden and challenging to detect. Firstly, there are signs of structural deficiencies that result in substantial problems in the internal or external components of the body. Therefore, in this study, the researcher focuses on the structure impairment of PWDs using wheelchair. Below shown the percentage of population among disabilities in Malaysia.

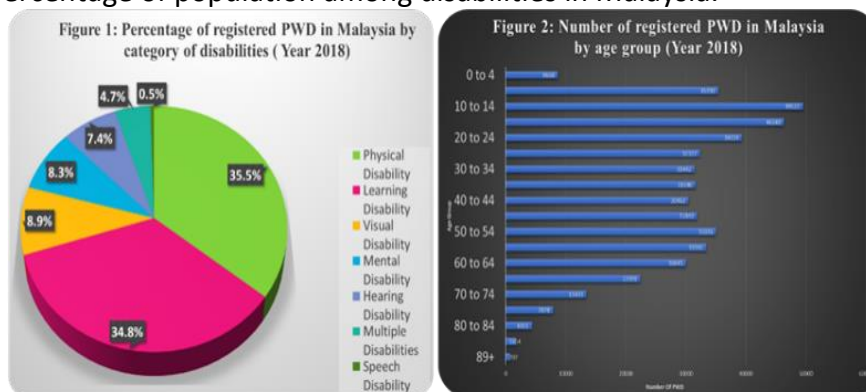


Figure 04– Percentage of Disability and update in Malaysia (PWDs)

Mobility Design System

According to Vitetta (2022) passenger mobility plays an important role in today’s society and optimized transport services are a priority. In recent years, MaaS (Mobility as a Service) has been studied and tested as new integrated services for users.

There are three categories of Mobility design system (MDS) in Malaysia namely the i) manual wheelchair, ii) motorized wheelchair and iii) smart wheelchair. A manual wheelchair’s feature, as defined by britannica.com, is any seating surface with wheels attached to it to assist an individual in moving from one location to another (DiGiovanni, 2014).

Methodology

In this research study, the Design and Develop Research (DDR) is deployed using ADDIE model (Analyze, Design & Develop, Evaluation) which was selected as the research design. The basic structure of this DDR method as per below;

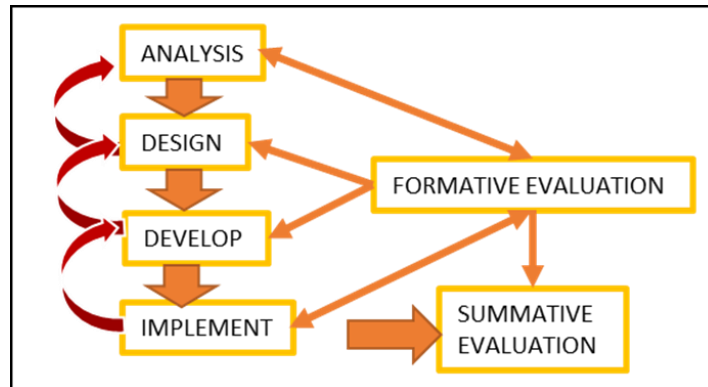


Figure 05 - Design Develop Research (DDR) method

The figure above illustrates the Design Develop Research (DDR) process, which comprises four distinct phases: i.) Problem analysis, ii.) Design and development, iii.) Implementation, and iv.) Validation. In this study, the researcher includes the process of designing, developing, and implementing in the second phase.

Case study, survey, and experimental design methodologies (as shown below) are frequently used to create and validate models describe below:

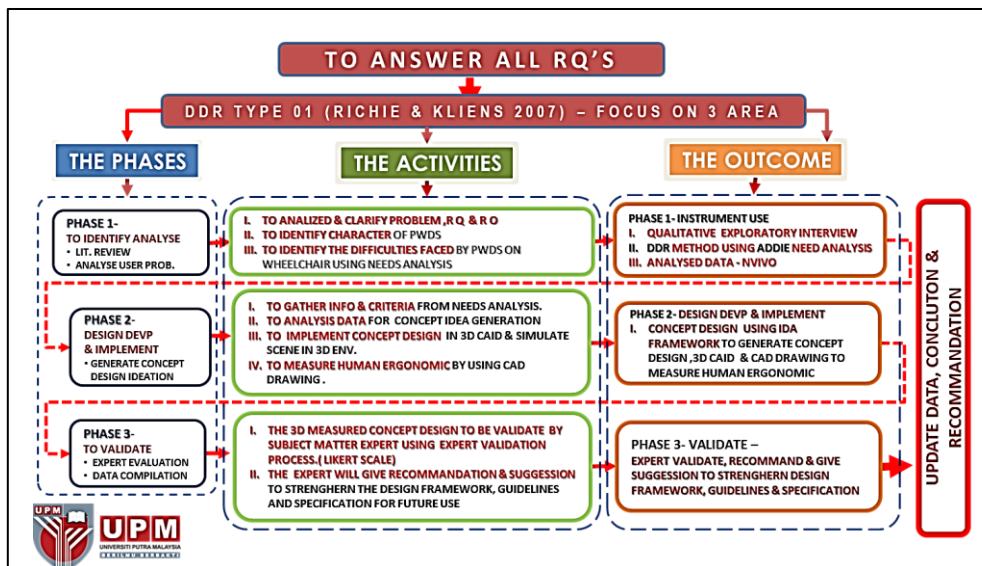


Figure 06 – DDR Conceptual Framework

Based on the method, the Design Develop Research framework will be sub divided into 3 main phases which are:

Phase 01 - The identification (Need Analysis)

In Phase 01 Need Analysis, the researcher will create and analyze an interview questionnaire utilizing Cohen Koppa anglesite, as well as interview people with disabilities to learn about their wheelchair-related everyday issues during the COVID-19 pandemic.

Phase – 02 a. Design development and b. Evaluation phase

The NVivo software will be utilized to do thematic analysis on the online interview data, resulting in the identification and categorization of themes and sub-topics.

a. Generating industrial design sketches.

b. Once approved, the sketch idea will be transformed into 3D models and situations using CAID to guarantee precise measurements and account for human factors. Once the matrix analysis has been conducted and the proposal has been strengthened, the process of expert validation can commence.

Phase - 03 - The validation and Evaluation phases

Simultaneously the researcher had interviewed five experts ((to validate and evaluate), including product development officers, engineers, industrial designers, and disability organization officers, to learn more about disability products and the experiences of persons with disabilities (PWD).

The researcher has carried out the exploratory research tools (online interview) using DDR method to organized the research phase into ADDIE structure (Analyze, Design, develop and implement, Evaluate and analyze). Each of the stages using difference type of analysis.

Findings and Discussion

Based from the social findings from users (based on their difficulties, different characters of usage and lack of local design contents) the researcher developed a concept of MDS utilizes the design framework of inclusive design and employs the method of DDR to address the needs of individuals with disabilities who use wheelchairs, with the aim of resolving their current issues. The sample o concept design is as per below:

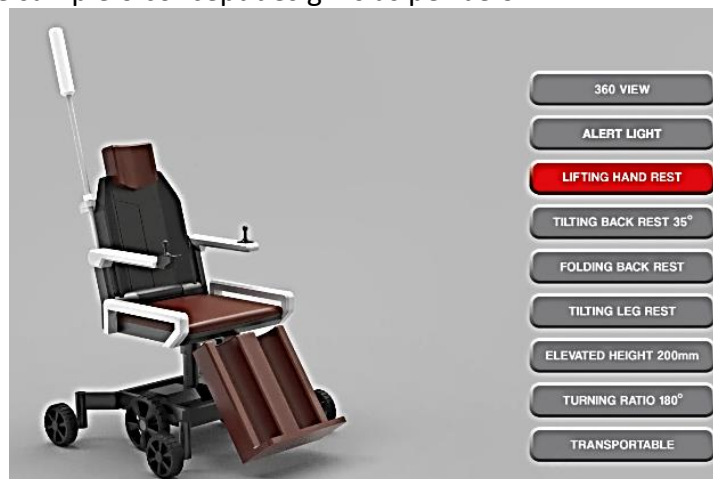


Figure 07 – MDS Concept design based from Inclusive design framework

Consequently, the design suggestion concept rooted in the Inclusive Design Approach (IDA) will effectively address the majority of the significant issues and obstacles encountered by wheelchair users with impairments (base from the findings mentioned above).

In conjunction to this, it will benefit certain group of people as user self-independent, the users can freely use the product by themselves with minimal assist from others, new knowledge in product development as a guidance for industrial designer and manufacturers, as well as gaining pubic awareness on the subject studied.

Reference

- Shafiq, H. (2014). Issue and Challenges Faced by Person with Disabilities, International Islamic University Malaysia (IIUM)
- Yen, Y. Y. (2022). Innovation management involvement among persons with disabilities in Malaysia. F1000 Research,
- Lorentzen, L., & Hedvall, P. O. (2018). Bringing human diversity into design processes through empathic modelling. *Studies in health technology and informatics*, 256, 128-136
- Latorre, S. (2016). Approaches to innovation in performance enhancement: " design thinking" and prospective ergonomics. In *Proceedings of the 15th Ergo'IA" Ergonomie Et Informatique Avancée" Conference* (pp. 1-5).
- de Domingo, K. (2013). Assistive technology for cognition: Perspectives on funding. *Perspectives on Neurophysiology and Neurogenic Speech and Language Disorders*, 23(2), 84-89.
- Khalili, M., Van der Loos, H. F. M., & Borisoff, J. (2018). Towards an autonomy-based approach to design and develop mobility assistive technologies for spinal cord injury populations. *Perception*, 10, 11.
- Luccarelli, T., Badano, P., Bricalli, G., Tennø, H., Mazzucchelli, M., Bigliocchi, S., & Cantonale, E. O. Multi-disciplinary and lean innovation for AT.
- Coleman, C. L., & Weinstock, R. F. (1984). Physically handicapped blind people: adaptive mobility techniques. *Journal of Visual Impairment & Blindness*, 78(3), 113-117.
- Mackay, D., & Smith, M. (2016). Inclusive design of a strategy making process.
- Tosi, F., & Pistoiesi, M. (2023). Inclusive Environments: Utopia or Reality? How to Create Inclusive Solutions Starting From People's Needs. *diid—disegno industriale industrial design*, (79), 10-10.
- Jordan, P. W. (2000, July). Inclusive design: An holistic approach. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 44, No. 38, pp. 917-920). Sage CA: Los Angeles, CA: SAGE Publications.
- Waller, S., Bradley, M., Hosking, I., & Clarkson, P. J. (2015). Making the case for inclusive design. *Applied ergonomics*, 46, 297-303.
- Ronald Mace (1997), The 7 Principles | Centre for Excellence in Universal Design. <https://universaldesign.ie/What-is-Universal-Design/The-7-Principles/>
<https://www.malaysia.gov.my/portal/content/30155>
- Vitetta, A. (2022). Sustainable Mobility as a Service: Framework and transport system models. *Information*, 13(7), 346.
- Carmen, P. D. (2014), <https://www.britannica.com/topic/wheelchair>, (The Editors of Encyclopedia Britannica)