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# Designing a Virtual Reality Video for Disability Inclusion: An Action Design Research

Short Paper

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## Abstract

*Social inclusion of people with disability is one of the priorities of the United Nations Sustainable Development Goal 10 – Reduced Inequalities. However, people with disability still face exclusion in society, such as inaccessible facilities and negative social attitudes. In this research, we explore virtual reality (VR) as a tool to raise the general public's awareness of disability. We conduct an action design research to develop an immersive VR video that promotes disability inclusion, in collaboration with disability practitioners, VR practitioners, disability researchers, and individuals using wheelchairs. In this Short Paper, we present three initial design principles that are critical to addressing three key challenges in disability awareness raising. Our VR artefact, once completed, will serve as a tool for disability awareness raising. The prescriptive knowledge developed could inspire Information Systems researchers and practitioners to explore a similar class of artefacts that promote social inclusion through cultivating awareness and behavioural changes.*

**Keywords:** Action design research, disability inclusion, virtual reality, digital sustainability, sustainable development goals

## Introduction

Over one billion people, or 15% of the world's population, live with a disability (World Health Organisation 2021). The number of people with disability is increasing, in part due to ageing populations and increasing chronic health conditions (World Health Organisation 2021). However, as the United Nations stated in Sustainable Development Goal (SDG) 10 - Reduced Inequalities, people with disability remain one of the most excluded groups in society (United Nations 2018). Inaccessible environments (e.g., inaccessible facilities and infrastructure) and negative attitudes (e.g., bias, stereotypes, and discrimination) produce barriers and prevent people with disability from fully participating in all aspects of their daily activities, leading to the social exclusion of people with disability (United Nations 2016; 2018).

Disability practitioners have been striving to promote disability inclusion by raising the general public's disability awareness and cultivating pro-social attitudes and behaviours (Sayers 2006). In this research, we aim to contribute to disability inclusion through an action design research (ADR) project in collaboration

with an Australian University. This university aims to explore the use of digital technologies as innovative tools for its disability awareness-raising practices. This is because existing disability awareness-raising tools (e.g., simulation exercises, curriculum, and workshops) have been ineffective in promoting disability inclusion (Hollo et al. 2021; Lindsay and Edwards 2013). For example, one of the criticisms is that existing tools unavoidably direct the general public's attention to the physical or mental impairment experienced by the person with disability, rather than critique the physical and social environments around the person (Nario-Redmond et al. 2017; Olson 2014). Having identified this real-world challenge, we embarked on an ADR project to design an information systems (IS) artefact that could raise the general public's disability awareness and cultivate pro-social attitudes and behaviours to promote disability inclusion.

This research proposes the development of a virtual reality (VR) video artefact as an innovative awareness-raising tool for disability inclusion. By placing users' focus on the immersive environment in VR, VR simulates and makes obvious inaccessible environments and negative social attitudes (Jensen and Konradsen 2018). VR also has great potential to be used for disability awareness raising because it can elicit empathy (Schutte and Stilinović 2017) and facilitate behaviour changes (Raij and Lok 2008). While IS research has explored the design of virtual worlds or virtual environments (Chaturvedi et al. 2011; Davis et al. 2009; Pannicke and Zarnekow 2009), the design of immersive VR videos is less explored, except for a recent study in which VR was designed for safety training (Haj-Bolouri and Rossi 2021). To the best of our knowledge, there is no major research in the existing IS literature dedicated to the design or use of VR for disability inclusion. While an increasing number of disability practitioners are seeking alternative solutions, including VR technology, to address disability inclusion, they lack evidence-based guidelines that could support them in creating effective VR disability awareness-raising tools. Thus, to advance the understanding of disability awareness raising and derive design principles that could support the design of an immersive VR video for disability inclusion, this research addresses the following research question:

How to design an effective virtual reality video for disability inclusion?

This research adopts the action design research (ADR) methodology proposed by Sein et al. (2011). Our ADR team is multidisciplinary, involving IS researchers, disability practitioners, VR technology and media practitioners, disability researchers, and a marketing researcher. While acknowledging the varied experiences of people with different types of disabilities, this ADR project focuses on people using wheelchairs and works directly with 18 wheelchair users to co-create an immersive VR video. In this short paper, we present the insights derived from the Problem Formulation stage we have completed. The Alpha cycle of the building, intervention, and evaluation (BIE) of the artefact is currently ongoing. We envision conducting a two-cycle ADR. The completed VR artefact will be adopted by our partner as part of their disability awareness-raising to promote disability inclusion on campus and more broadly in the community.

## **Virtual Reality for Disability Inclusion**

This study understands disability through the view of the social model of disability, which is one of the central principles and beliefs of disability studies (Oliver 2013; Union of the Physically Impaired against Segregation 1976). It claims that disability should be understood as a way that society fails to cater to people with disability, rather than what the impaired bodies or minds of people with disability cannot do (Oliver 2013; Union of the Physically Impaired against Segregation 1976). Take people using wheelchairs as an example. Society fails them not only in inaccessible physical environments but also in prejudiced social attitudes that stigmatise, devalue, and discriminate against them (United Nations 2018). Thus, to promote disability inclusion, we must raise people's awareness of inaccessible environments and negative social attitudes and call for action changes.

Disability awareness tools have been widely adopted in practice to equip people with disability knowledge and cultivate their pro-social attitudes and behaviours (Lindsay and Edwards 2013). Commonly adopted tools include simulation exercises, curriculum, workshops, documentaries, films, and social contact with people with disability. However, disability practitioners and researchers have suggested that existing interventions are insufficient in raising disability awareness. For example, disability simulation exercises, which ask a person without disability to undertake activities using a wheelchair, elicit pity and reinforce negative stereotypes (e.g., degrees of incompetence and neediness) towards people using wheelchairs (Hollo et al. 2021). This failure is because the exercises focus on simulating the impairments, and therefore the design unavoidably directs people's attention to the inabilities (Nario-Redmond et al. 2017; Olson

2014). Other tools, such as videos and discussions, also did not have a significant impact on improving attitudes and acceptance toward people with disability (Godeau et al. 2010; Pitre et al. 2007; Swaim and Morgan 2001). A new disability awareness-raising tool is therefore needed.

In this paper, we explore the use of VR as an awareness-raising tool for disability inclusion. VR is a set of technologies that give people an immersive experience of a virtual world beyond physical reality (Haj-Bolouri and Rossi 2021). Existing research inform three potentials of VR that could be utilised in the disability inclusion context. First, VR enables users to experience a sense of presence in a simulated environment and focus on interacting with the environment (Jensen and Konradsen 2018). Similarly, VR could simulate the environments that people using wheelchairs experience and place viewers' focus on the inaccessible facilities and poor social attitudes and behaviours happening in the environments. Second, an extensive number of studies have suggested that VR is effective in enabling perspective-taking and eliciting empathy, especially towards groups who experience marginalisation (Herrera et al. 2018; Schutte and Stilinović 2017). This potential of VR could be used to help the public understand people with disability's situations and feelings of being excluded. Third, a handful of experimental studies have successfully used VR to facilitate social attitudes and behaviours adjustments (Raij and Lok 2008). Applying it in the disability inclusion context, VR could increase viewers' awareness of their inappropriate attitudes and behaviours when interacting with people with disability, such as people using wheelchairs. Taken together, insights drawn from existing studies have suggested that VR could be suitable to be used as an awareness-raising tool for disability inclusion.

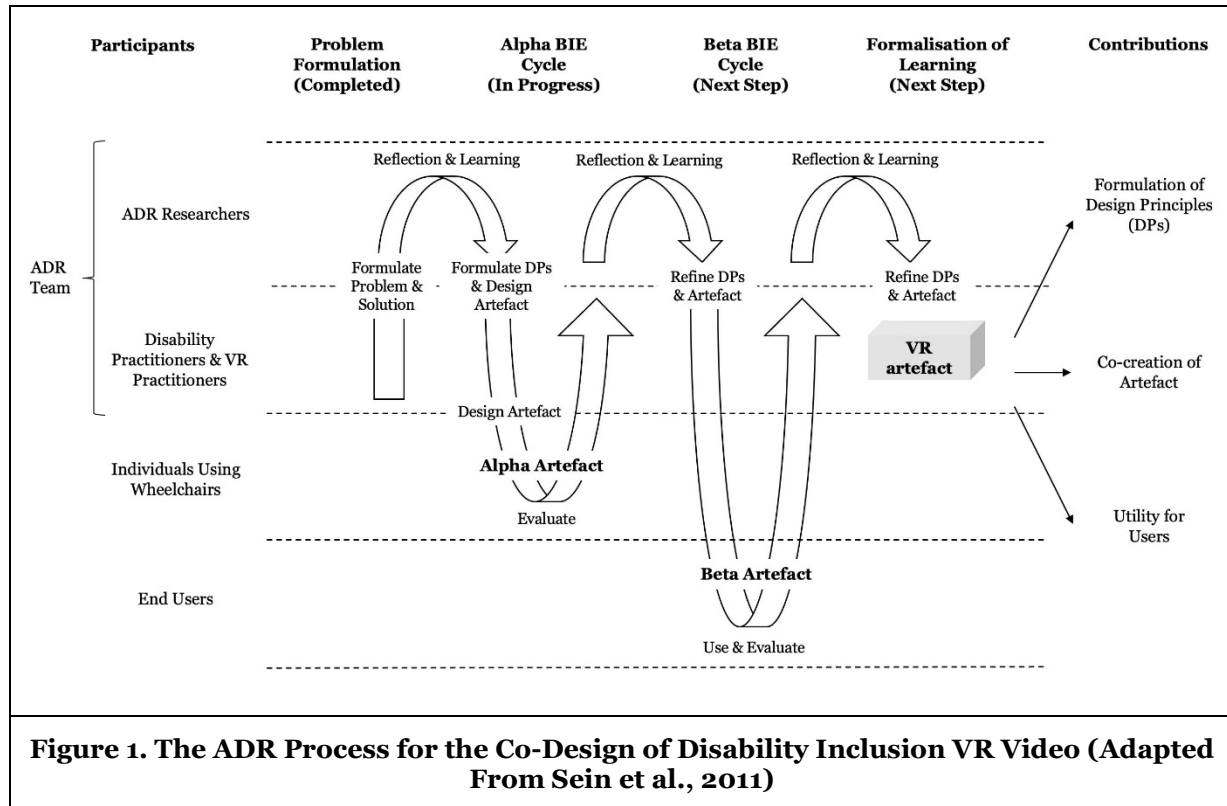
Nevertheless, applications of VR for disability awareness raising are scarce. Prior research and practices have predominately used VR as an assistive tool for people with disability. For example, VR is popular in medical treatment, rehabilitation, social skill practices, and out-of-reach experience fulfilment of people with disability (Maples-Keller et al. 2017; Renault 2018; Virtual Ability 2022). However, the use of VR for promoting disability awareness and cultivating pro-social attitudes and behaviours of the public is less explored. This study attempts to fill this gap by generalising design knowledge about how to design an effective VR video for disability inclusion through the ADR approach.

## **Action Design Research**

We adopt the ADR approach proposed by Sein et al. (2011) to develop and test design principles for a VR video for disability inclusion. The ADR approach is “a research method for generating prescriptive design knowledge through building and evaluating ensemble IT artefacts in an organisational setting” (Sein et al. 2011, p. 40). It allows us to design our artefact in situ, taking into consideration the organisational context. Moreover, the ADR methodology emphasises the inherently interwoven activities of building, intervening, and evaluating the ensemble artefact with both researchers and practitioners in an organisational context. This is in line with this project, where researchers, disability practitioners, VR practitioners, individuals using wheelchairs, and end users have worked together to shape the development and use of the VR artefact over rounds of discussions and evaluations (see Figure 1). We thus chose the ADR model of Sein et al. (2011) as our research methodology.

Our ADR follows four stages proposed in Sein et al. (2011), as indicated in Figure 1. In the Problem Formulation stage, we identified three key challenges in disability awareness raising, drawing from the empirical investigation with practitioners and extant research. Through ongoing reflection and learning during the Alpha BIE stage, we formulated the initial set of design principles and built the initial VR artefact over rounds of discussions with the ADR team. The next step of this project is to continue the ongoing refinement of the VR artefact in the Alpha BIE and Beta BIE cycles. Ultimately, we will conceptualise our learning into a final set of design principles for designing an effective VR artefact for disability inclusion.

Due to the socio-technical nature of our VR artefact, we use the technology affordance theory as the theoretical lens. The technology affordance theory enables us to understand how humans interact with an artefact in a social environment (Volkoff and Strong 2017; Majchrzak and Markus 2012; Markus and Silver 2008; Pan et al. 2021). Technology affordance is useful to our ADR study because it uncovers the interactions among designers, artefacts, and users (Maier and Fadel 2009). It suggests that we designers should identify a set of user-required affordances of the VR artefact and develop the artefact features which provide these affordances. In other words, the technology affordances perspective sensitises us to explore how the VR artefact will be used by users to promote disability inclusion.



### ADR Setting

Our ADR project is initiated along with the division of Equity, Diversity, and Inclusion (EDI) of a university in Australia. This division is responsible for implementing strategies, initiatives, training programs, and events to make a positive impact on social inclusion within the university and the globe. As the challenges persist in promoting disability inclusion, EDI has launched a brunch of initiatives to support interdisciplinary disability research and hopes to innovate the use of digital technologies for its disability awareness raising practices. By collaborating with the university and the EDI, we undertake this ADR project with a multidisciplinary team. We engaged people using wheelchairs throughout the design process, as guided by the United Nations Disability Inclusion Strategy (2019) guidelines. Table 1 details the ADR team members and research participants, including their responsibilities till the building stage of the Alpha BIE cycle. ADR team members are from the university community and the industry.

ADR Team Members	Responsibilities
Three disability champions and two disability service providers	-Provide information and insights about the practice of promoting disability inclusion -Evaluate the VR film script
Two disability researchers	-Provide research background about and insights into disability inclusion -Evaluate the VR film script
Three directors and writers specialised in disability-related content creation	-Develop VR story and film script -Evaluate the VR film script
Five VR technology and media practitioners	-Execute the filming of the VR video -Design the VR video -Execute the post-production of the VR video

Three IS researchers and one marketing researchers	-Identify the research opportunity -Identify the required affordances -Organise meetings and collect data -Formulate the initial design principles
Research Participants	Responsibilities
18 individuals using wheelchairs	-Provide personal experiences and stories about disability -Evaluate the VR film script
Actors	-Perform for the VR video
<b>Table 1. Responsibilities of the ADR Team Members and Research Participants</b>	

### **Problem Formulation**

We began the ADR with a problem formulation stage to identify the knowledge creation opportunity and formulate the problem. First, we positioned our research as disability inclusion promotion through disability awareness raising. To gain a deep understanding of disability awareness raising, we conducted three rounds of semi-structured interviews with disability practitioners (including disability champions and disability service providers) and disability researchers to specify key challenges in disability awareness raising to be addressed and their perspectives on solutions. We also conducted a thorough investigation of the literature on different types of disability awareness interventions and their strengths and limitations.

As a result, we identified three key challenges in raising disability awareness to be addressed: (1) lack of knowledge, (2) lack of empathy, and (3) lack of behavioural changes. Therefore, the preliminary requirements of the artefact to be built are to provide disability knowledge, elicit empathy, and facilitate behavioural changes. Guided by the technology affordance theory (Maier and Fadel 2009; Strong et al. 2014), we refined these preliminary requirements into the form of required preliminary affordances that the artefact should allow for and purposely designed them.

The first preliminary affordance is exposure. Disability practitioners, disability researchers, and individuals using wheelchairs suggested that the general public often lacks knowledge about disability and disability etiquette (Ison et al. 2010; Lindsay and Edwards 2013). Thus, the VR video should serve as a means of exposing people to relevant knowledge, such as accessibility standards, commonplace prejudiced stereotypes associated with people using wheelchairs, and etiquette that can be used to interact with them. For example, a disability champion on our ADR team observed:

*“I don’t think there’s enough information out there ... More education about the needs of people with disabilities and what they require [is needed].”*

The second preliminary affordance is empathy. It is difficult for people without disability to empathise with people using wheelchairs and understand how it feels like living with inaccessible environments and negative social attitudes (Wijma et al. 2018; Lindsay and Edwards 2013). Therefore, the VR video should afford the perspective taking and support the public in empathising with people using wheelchairs. A disability researcher on the ADR team felt excited about the potential of VR to facilitate empathy:

*“It [VR] gives people [the] opportunity to experience what it’s like in the situation ... [and] help[s] them to identify some of the challenges that are out there that don’t necessarily have to be challenges.”*

The third preliminary affordance is empowerment. Existing practice and research often found that positive behavioural intentions and changes do not necessarily happen after disability awareness training (Pitre et al. 2007; Lindsay and Edwards 2013). Thus, the VR video should cultivate intentions of pro-social behaviours and empower people to be confident in interacting with people using wheelchairs. A research participant using wheelchair on the ADR team gave an example of behavioural changes:

*“Oh, I shouldn’t stare. I don’t want to give that person so much attention that he feels awkward.”*

### Initial Design Principles Formulation in the Alpha BIE Cycle

The Alpha BIE cycle started with the identification of initial design principles. We followed the widely used design principles template of Chandra et al.'s (2015) to structure our design principles. These design principles and design features were developed over rounds of discussions with disability and VR practitioners. Figure 2 shows our development process from affordances, initial design principles and system features. Descriptions in Table 2 highlight critical considerations to implement design principles into VR artefact features.

Affordances	Design Principles	Descriptions	VR Artefact Features
Exposure	Provide features to advance knowledge regarding inaccessibility and negative social attitudes in authentic life scenarios so that the VR video can afford users to have exposure to disability knowledge to promote disability inclusion.	<ul style="list-style-type: none"> <li>-Narrative VR is useful in delivering disability knowledge.</li> <li>-Authenticity of the storytelling and the photography are keys to immersion and influence the learning outcomes in VR.</li> </ul>	<ul style="list-style-type: none"> <li>-Narrate a story that contains critical knowledge about inaccessibility and negative social attitudes.</li> <li>-Visualise the photography of actors, sets, and props that represent authentic life scenarios.</li> </ul>
Empathy	Provide features to embody multiple actors so that the VR video can afford users to empathise with those who live with inaccessibility and receive negative social attitudes to promote disability inclusion.	<ul style="list-style-type: none"> <li>-First-person view of VR is effective in eliciting empathy through perspective-taking of the actor using a wheelchair.</li> <li>-Third-person view of VR is effective in eliciting empathy through the observation of the actor using a wheelchair and the surrounding environment.</li> </ul>	<ul style="list-style-type: none"> <li>-Visualise the display from a first-person view to embody a person with disability.</li> <li>-Visualise the display from a third-person view to observe how individuals without disability interact with a person with disability.</li> </ul>
Empowerment	Provide features to compare different social behaviours so that the VR video can afford users to feel confident about interacting with people using wheelchairs to promote disability inclusion.	<ul style="list-style-type: none"> <li>-Scenario-based learning is a good way to deliver practical knowledge and skills to interact with people using wheelchairs.</li> <li>-Actionable insights are a key to long-lasting behavioural changes towards people using wheelchairs.</li> </ul>	<ul style="list-style-type: none"> <li>-Simulate the users' decision path in disability exclusion scenarios.</li> <li>-Visualise the consequences of users' decisions in disability exclusion scenarios.</li> </ul>

**Table 2. The Initial Set of Design Principles**

### VR Artefact Building in the Alpha BIE Cycle

Next, guided by the initial design principles, we developed a film script that would allow us to portray the inaccessible environments and negative social attitudes experienced by people using wheelchairs in the VR video artefact. Specifically, we conducted 18 in-depth semi-structured interviews with people using wheelchairs. Accommodations (e.g., easy-read recruitment posters and accessible interview venues) were made throughout the interview process. We analysed these interview data and coded common social life stories that could be potentially narrated in the VR video. We then worked with directors and writers who specialise in disability-related content creation to generate a first draft of the script. The draft film script

was developed and revised over several iterations with the researchers, disability champions and some of the interview participants. Our finalised, co-designed script represents three typical social life stories of people using wheelchairs. The first story narrates the interaction among a person using a wheelchair, a six-year-old girl, and her mother, discussing the causes of disability. The second story highlights how the inaccessible facilities in a restaurant disable a person using a wheelchair. The final story presents the poor customer service faced by a person using a wheelchair and the prejudiced attitudes and inappropriate behaviours experienced by this person.

With the initial design principles and a film script, we proceeded with the VR video filming and post-production by working with VR and media practitioners. Guided by the design principles, we adopted live-action filming to visualise the learning environment and provide users with a sense of authenticity. We hired a café as a filming venue and arranged the scene to be as close to that of an operating café as possible. Moreover, we recruited actors (including the leading actress using a wheelchair) and extras for the performances. The first and fourth authors of this paper and media practitioners coordinated the filming and performed in the video. From the footage, we developed a set of four VR videos featuring good and bad education examples from first- and third-person points of view. Users can choose to watch one or more videos, and each video is about three minutes long.

## **Future Plans and Expected Contributions**

The next steps for this project are as follows. First, we will continue with the Alpha BIE cycle to evaluate the initial design principles and the VR artefact within the ADR team. We expect to discover both expected and unexpected consequences of the initial design principles through reflection and learning. Second, during the Beta BIE cycle, we will revise the design principles and iteratively refine our VR artefact through interventions and evaluations in the actual use setting with our target end users. Specifically, we plan to invite 20-30 individuals to watch the VR video and collect their feedback through an evaluation study. We intend to evaluate their knowledge learning, empathy, and intentions of attitude and behaviours changes after watching the VR video. Lastly, in the Formalisation of Learning stage, we will finalise our design principles following the template prescribed by Gregor et al. (2020).

This paper introduced an initial set of design principles for creating a VR video to be used for disability inclusion through disability awareness raising. This research is expected to make three contributions. First, the VR video will be included in a toolbox of disability awareness-raising approaches to help the university promote disability inclusion. The VR video could be integrated into disability awareness training materials and promote social inclusion within the university. It could be also showcased in the university's public communications, thus influencing society. By doing so, this research addresses a real need for an innovative disability awareness-raising tool and contributes to disability inclusion highlighted in the SDG 10-Reduced Inequalities. Second, this research is expected to advance our understanding of disability awareness raising and to develop a solution for disability inclusion. We identified three key challenges in disability awareness raising work – lack of knowledge, lack of empathy, and lack of behavioural changes. In response, we proposed a 3E solution – Exposure, Empathy, and Empowerment to improve disability inclusion. Third, we argue that this research would contribute to prescriptive knowledge by defining a set of design principles with which to construct a VR video for disability inclusion. This prescriptive knowledge could inspire IS researchers and practitioners to explore a class of IS artefacts that promote awareness and pro-social behaviours towards other disadvantaged groups, thereby contributing to advancing SDG 10- Reduce Inequalities.

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