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To cite this article: Per-Olof Hedvall, Agneta Ståhl & Susanne Iwarsson (21 Apr 2025): Accessibility, usability and universal design – still confusing? Harmonisation of key concepts describing person-environment interaction to create conditions for participation, Disability and Rehabilitation, DOI: [10.1080/09638288.2025.2491831](https://doi.org/10.1080/09638288.2025.2491831)

To link to this article: <https://doi.org/10.1080/09638288.2025.2491831>



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Published online: 21 Apr 2025.



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Accessibility, usability and universal design – still confusing? Harmonisation of key concepts describing person-environment interaction to create conditions for participation

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ABSTRACT

Purpose: To contribute to an in-depth understanding of how the concepts accessibility, usability, and universal design interact and can be harmonised to create conditions for participation in the 21st century.

Material and Methods: Ideas, empirical research, and selected literature from health science, engineering, and design constituted the material for a scientifically grounded analysis.

Results: We describe recent developments, how the concepts relate to and complement each other, and the synergies they create. Reflecting on the lack of clarity in their application, we argue that definitions are crucial and that the concepts can be combined and harmonised in a synergistic entity: The *participation of all* is the ultimate goal of society. *Universal Design* is the value-based vision and approach to design grounded in human rights that, through intersectionality and involvement, should permeate all aspects of society to create the best possible conditions for participation for all citizens. *Accessibility* and *usability* are tools for operationalising and translating universal design into practice, applicable at the individual, group, and societal levels.

Conclusion: Intended for implementation at all these levels, we propose a harmonised model where the concepts are explicitly defined and closely connected, with each other and the conditions to reach participation at scale.

ARTICLE HISTORY

Received 28 May 2024

Revised 4 April 2025

Accepted 7 April 2025

KEYWORDS

Participation; disability; conceptualisation; human rights; CRPD; Agenda 2030

> IMPLICATIONS FOR REHABILITATION

- Accessibility, usability, and universal design can and need to be used simultaneously in all processes to create the best possible conditions for participation.
- We propose a harmonised model for how the concepts can be understood and used together in a synergistic entity.
- Applying the proposed model, rehabilitation professionals can contribute advice to improve person-environment interactions, addressing the individual, group or societal levels in a stringent manner.

Introduction

People's life trajectories are shaped by many factors, including the environments, products and services they encounter and interact with over time. Reflecting on the close to 1,300 citations of Iwarsson & Ståhl's paper published in *Disability & Rehabilitation* in 2003, accessibility, usability, and universal design (UD) are concepts of major interest worth consideration as drivers to create conditions for participating in and contributing to society. Even though these concepts have been around for more than thirty years, there is still significant confusion and lack of clarity in their application. The purpose of this paper is to describe recent developments and further explore how accessibility, usability, and UD relate to and complement each other, as well as the synergies they create, and to contribute to an in-depth understanding of how the concepts interact and can be harmonised to create conditions for participation in the 21st century.

This paper is based on ideas, empirical research, and documentation from the authors' respective areas of specialisation (design, engineering, health sciences) as well as scholarly literature from relevant knowledge fields. Selected to add to the depth, validation and contrasting of the results and conclusions, we used this material for a scientifically grounded analysis. We primarily concentrate on the physical environmental conditions that support participation, that is, factors usually described by the concepts accessibility, usability and UD. A large proportion of situations in which individuals find themselves throughout life have significant physical characteristics. For people who live with long-term or periodical impairments, the physical aspects of the environment constitute basic conditions and prerequisites for participation. At first, this focus may seem somewhat narrow, but throughout life, these aspects manifest in the designs we encounter in urban environments, housing, transportation, commerce, education and work.

The paper published by Iwarsson and Ståhl [1] to a considerable extent relied on the conceptualisations and definitions in the *International Classification of Functioning, Disability and Health (ICF)*, which at that time had been recently endorsed by all 191 WHO Member States as the international standard to describe and assess health and disability [2]. While still in use and often cited in healthcare contexts, global policymaking has advanced and introduced additional conceptualisations and goals that are relevant when revisiting the analysis of accessibility, usability and UD.

To date, 185 of the current 193 UN Member States have ratified the *Convention on the Rights of Persons with Disabilities (CRPD)* [3] and thus committed to creating societies with full participation of all. As a starting point, this means that the design of products, environments, programmes and services must not be based on special treatment for certain people, which promotes inequality and stigmatisation. Instead, the ratifying states undertake to promote, protect, and ensure equal conditions for all, including persons with impairments, to enjoy “all human rights and fundamental freedoms” [3,p.6]. The starting point is that all people have equal value and equal rights and that it is the duty of the states to ensure that everyone has equal opportunities to participate in and contribute to society.

In addition, there have been major breakthroughs regarding sustainability, where the *Agenda 2030* slogan “Leave no one behind” has been enthusiastically supported globally. In the same spirit as the CRPD, Agenda 2030 focuses on all people, which means that inclusion and equality have gained a stronger foothold in national and international policies and guidelines. Several of the 17 sustainable development goals contain wording underpinned by and referencing inclusion, which is viewed as an important condition for participation. Two such examples are Goal 10: Reducing inequality – Reducing inequalities within and among countries, and Goal 11: Sustainable cities and communities – Make cities and human settlements inclusive, safe, resilient and sustainable.

In this paper we use the terms “impairment” and “disability” in line with the social and human rights models of disability [4], and described as follows in the CRPD:

disability results from the interaction between persons with impairments and attitudinal and environmental barriers that hinder their full and effective participation in society on an equal basis with others [3, Preamble (e)].

Looking ahead, continued conceptual development involving accessibility, usability, and UD should explicitly consider participation in the light of the CRPD and Agenda 2030.

Participation – individual and societal perspectives

The multifaceted concept of “participation” has since long been a central part of governing documents, health care practices (particularly within rehabilitation) and research. Such application concerns opportunities for persons with impairments and older people experiencing functional decline due to age-related diseases or ageing per se to participate in and contribute to society. In the ICF [2], participation was defined as the individual’s involvement in a life situation, closely linked to the activity component and viewed as an aspect of health. That is, participation has often had a strong individual emphasis, but current conceptualisations simultaneously encompass the individual, specific groups or population segments, and society, as well as the relationships between these levels.

Participation is tightly connected to human rights and is an essential part of the CRPD, which emphasises the rights of persons with impairments to engage fully in society [5]. Defined in this way, participation is not merely about physical involvement but encompasses all aspects of life. The CRPD mandates that states ensure “accessibility to the physical, social, economic and cultural environment, to health and education and to information and communication, in enabling persons with disabilities to fully enjoy all human rights and fundamental freedoms” [3, Section Preamble (v)]. The right for persons with impairments to participate in and be actively involved in matters that affect them is fundamental [3, Articles 4.3 and 33.3]. The CRPD highlights society’s responsibility to ensure equal access for all people. The individual is seen as embedded in and dependent on these opportunities rather than being a separate and independent entity [6].

Accordingly, participation is positively charged and manifests in the interaction between the individual and the environment, which means that the concept has a process character. It is thus conceptualised in a manner similar to the concept of disability, which is likewise manifested in the interaction between the individual and the environment [7,8].

Accessibility – objective indicators of person-environment interactions

“Accessibility” is a simplified but still remarkably complex way of viewing the multifaceted everyday reality that people experience, for example, in the different environments they wish to, can, or must inhabit. The term was coined after the Second World War when soldiers returned from the war with severe impairments, often with extensive rehabilitation needs. It became evident that neither housing nor society in general were adapted to accommodate, for example, people who used wheelchairs, which highlighted the need to adapt the physical environment [9]. In the historical sense, accessibility implies that it is a matter of adapting already existing environments to the requirements imposed by the nature and characteristics of various impairments. This approach lies behind the development of guidelines and standards in terms of measurable dimensions and specifications. The emergence of norms resulted in the possibility to measure and assess compliance with guidelines for accessible design. Accessibility is thus measurable and mainly objective in nature, which is important when accessibility is to be translated into practical measures in planning and detailed design. This kind of definition implies that accessibility problems should be expressed as a person-environment relationship and operationalised as the encounter between the person’s or group’s functional capacity and the design and demands of the physical environment [1,10]. Importantly, accessibility can be applied at the societal, group and individual levels. As accessibility is based on norms aspiring to meet the needs of most but not possibly all people in the population, the norms do always exclude some individuals [11]. Thus, individually targeted accommodations will always also be necessary.

Regarding current applications of the concept, particularly in policymaking and practice, accessibility is widely used in the adaptation of existing environments as well as when designing new buildings and environments. In the EN 17210, accessibility is defined as the “provision of buildings, parts of buildings, or outdoor built environments for people, regardless of disability, age or gender, to be able to gain access to them, into them, to use them and exit from them” [12]. It is also used in other fields and is part of several international standards, such as the EN ISO

9241-112, which describes accessibility as the “extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified contexts of use” [13]. Moreover, the concept is one of the guiding principles of the CRPD (Article 3), which deals with accessibility at the global and national levels, based on a population perspective that includes all citizens. The CRPD focuses on ensuring “access” for all (Article 9). The target group is not exclusively persons with impairments but “all potential consumers” [14,p.5]. The commitment to guarantee that the conditions for participation exist for the individual is expressed in several areas. One example is laid out in Article 19, “The right to live independently and be included in the community”:

States Parties to the present Convention recognize the equal right of all persons with disabilities to live in the community, with choices equal to others, and shall take effective and appropriate measures to facilitate full enjoyment by persons with disabilities of this right and their full inclusion and participation in the community [3, Article 19].

The population is diverse, and people interact with/in a variety of environments. This implies that encounters between individuals and the environment represent a vast number of combinations and situations, which makes the realisation of accessibility on the societal level a very complex task. Furthermore, planning and construction processes involve a host of different actors, often with varying or insufficient knowledge of the requirements imposed on the design of the environment for individuals and groups with different types and combinations of impairments [15].

In practice, efforts to improve accessibility often centre around creating compromises and optimisations that are based not only on standards but also on descriptions of functional ability at the group level, and the difficulties and challenges these can entail in different environments [16]. The dominant perspective is based on grouping people into population categories based on different diagnoses and associated functional limitations, or on data on functional limitations typically associated with ageing [17]. Thus, accessibility is defined as a relationship – the encounter between a person with impairments and the design of the physical environment [1]. This definition is more complex than would appear at first glance, as different types of impairments place different demands on the design of the environment.

At the societal level, issues concerning accessibility also find their way into the policy agenda due to the demographic shift towards rapidly ageing populations. Many older people, particularly the oldest old, have moderate or severe impairments, requiring accessible housing, neighbourhoods and public environments. Against this background, laws and regulations for the design of public spaces and private housing have been enforced. For example, in Sweden, according to the current guidelines for housing construction, at least one bathroom on the entrance floor must have an unobstructed floor area of at least 130cm in diameter. These dimensions create good conditions for a large proportion of the population – including those who use a walker or manual wheelchair – to access the bathroom. Still, there are individuals for whom this space requirement does not suffice.

At the group level, applicable requirements can sometimes contradict one another, which needs to be resolved through optimisation and compromises. A classic example of such a challenge in public environments is that design details ensuring level access to persons who use wheelchairs can lead to accessibility problems for those with visual impairments. That is, because this group often uses edges to orient themselves (e.g., using a white cane),

floor or ground material without any physical contrast is problematic.

At the individual level, accessibility is a crucial part of the relationship between the individual and the environments they encounter. Accessibility affects individuals both in concrete, day-to-day situations, and throughout their lifespan. A definition commonly applied at the individual level is that accessibility is equal to “person-environment fit” [18], with the relationship between the individual’s capacity and the demands of the environment at the core [1]. Noteworthy, many countries have enacted legislation that allows people who live in housing that is not suitable for persons with impairments to receive financial support for individual housing adaptations [19].

Usability – individuals’ perceived perspectives on the outcome of person-environment interactions

Turning to “usability,” this term has found its way into policy documents, legislation, and regulations in the past three decades. The International standard ISO 9241-11 describes usability as the “extent to which a product, a service and the built environment can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (2018). This definition highlights the importance of considering not only the functionality but also the user experience. Prevailing definitions are mainly applicable to products, systems, and services in, for example, the field of Information and Communication Technologies [20]. As to conceptual definitions and operationalisations applicable to physical aspects of environments, in comparison with accessibility, usability has been less elaborated on. However, usability for persons with visual impairments stands out as a positive example, where guidelines and specifications based on practical tests have been translated to standards with global application [see e.g., ISO 23599, 21].

According to Iwarsson and Ståhl [1], somewhat contrasting accessibility, which can be observed and measured objectively, usability is a subjectively based concept describing how people perceive and experience environments. That is, usability can be expressed as how well the design of an environment enables individuals and groups to occupy and use it, thus applicable to digital as well as physical environments.

Defined as the transaction of the individual, the physical environment and daily tasks performed at home, usability in housing environments has been operationalised in the self-rated Usability in My Home Instrument (UIMH) [22]. Supported by a psychometric study including the UIMH [23] based on data from several countries, usability has been established as one of four perceived aspects of housing that deserve attention in research on ageing and housing. Alternative ways to capture usability related to physical environments are qualitative or mixed methods designs.

A closer examination of the person-environment interaction suggests that objective accessibility does not always stipulate perceived usability, which appears to be malleable with age, self-perception, and functional capacity [24]. Such findings support the common practice to use accessibility and usability as an indivisible conceptual pair complementing each other and stress the importance of evaluating both objective and perceived indicators of person-environment interactions to design physical environments that support participation. Following the introduction of the CRPD, utilising accessibility and usability as twin criteria has also become a way to establish a more user-oriented conceptualisation of the relationship between those who use the built environment and the physical design of buildings [25,26].

Universal design – a value-based vision and approach to design grounded in human rights

In line with the increasing prominence of the CRPD, UD has taken a more prominent space in disability policies worldwide, not the least in Sweden [27,28]. In the CRPD, UD is presented as the overarching principle constituting a national commitment regarding everything new that is created in society. UD explicitly addresses the societal level and is a value-based design concept [29] that denotes a vision and a process. Importantly, the concept is used both as a verb (to design) and a noun (a design) in the English-speaking world. The process perspectives have been increasingly emphasised in recent years but have been a part of UD from the beginning [1].

UD emerged as a concept in the US in the 1980s, with architect Ron Mace as one of the leading persons [30,31]. UD initially emerged in response to what was perceived as a narrow focus on minimum accessibility requirements for persons with impairments. Such requirements were seen as an obstacle to creativity, with overly limited standards that sometimes stood in the way of inclusion and were often deficient in their capacity to address not only accessibility but usability as well. Mace defined UD as “an approach to design that incorporates products as well as building features which, to the greatest extent possible, can be used by everyone” [Mace 1988 in 10,p.1.5]. As Mace himself used a wheelchair, UD came to be associated with issues related to disability from its inception. Even today, UD is often understood as primarily concerning persons with impairments, which by definition is contradictory. Children are an obvious example, because most environments in society are not designed according to their characteristics in terms of bodily measurements. Furthermore, during the course of life, most people experience situations or periods when they themselves or someone close experience temporary or permanent impairments. As people age, everyone will experience some decline in functional ability. The definition of UD used in the CRPD makes it clear that the concept concerns all people:

It is the “design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design. “Universal design” shall not exclude assistive devices for particular groups of persons with disabilities where this is needed” [3, Article 2].

Accordingly, UD stands for a diversity of thought, which is as much about who is left- or right-handed, introverted, or extroverted, as how well a person can see, hear, or move. All human functions and characteristics fall under the umbrella of the concept, and not just cognition, vision, hearing, and mobility. However, it is worth noting that the UN definition of UD [3] implies a kind of concession to make the ambitious goals of UD realistic: “...all people, to the greatest extent possible”.

Early on, when UD was emerging as a new concept, a framework including seven principles was developed, intended to be used as guidance in design processes, evaluate designs, and educate designers as well as consumers [32]. These principles can be seen as an early gateway to thinking and working based on UD, but they are in constant need of development [33]. Over the years, the need to supplement these principles and bring in more perspectives and ways to express UD has increased. That is, there is a need to integrate contemporary socio-economic and socio-cultural perspectives and strengthen the principles in terms of systems and services [34]. To highlight the process character of the concept, Steinfeld and Maisel put forth a later definition of UD: “Universal design is a process that enables and empowers

a diverse population by improving people’s performance, health and well-being as well as social participation” [31]. They also introduced eight goals for UD, complementing the original seven principles and capturing aspects such as personal preferences and cultural values.

UD is neither a sub-category of design nor is it a special kind of process; UD is intended to be an integral aspect of ordinary design. Therefore, all design processes should incorporate the values and goals of UD, emphasising equity, non-stigmatisation, and intersectionality. Intersectionality means that several different categorisations are considered, for example, functional capacity, gender, and ethnicity. Attention to intersectionality implies having an awareness of several different and simultaneously interacting power structures and enables insights into the many different grounds for exclusion. In UD contexts intersectional thinking entails focusing on aspects other than disability alone [35].

Putting UD into practice is, therefore, about creating products, environments, programmes and services that work for everyone and avoiding, as far as possible, special solutions. In concrete development work, “equity” and “flexibility” (principles one and two of the seven original UD principles) are particularly important for understanding how UD can be realised in practice. Together, these two principles can be understood as a variety of people demanding a variety of ways to achieve equal or equivalent results, that is, meeting variation with variation. Flexibility is key to being able to design products, services and environments based on the principles of UD. In this way, the concept extends from concrete tools and methods for inclusive design to an inclusive culture, where UD is applied as a guiding principle in strategies to create conditions for full participation and equal living conditions.

Introducing UD thus requires a cultural transformation, and a paradigm shift with human diversity as the norm, with a corresponding policy shift that strives to create equitable conditions to enable participation for all. According to Ryhl, the understanding of UD as a value-based concept is close to Mace’s [36] early definition. Based on interviews with architects in Norway and Denmark she highlighted three levels of abstraction regarding UD: mindset, process, and solution [29]. Another three-level description was put forward by Lid [7,37]: macro, meso, and micro. Interestingly, while expressed in different ways both authors discussed UD at levels spanning from concrete solutions and situations to overarching societal perspectives.

Respecting the epistemological differences between the concepts, we argue that UD has to be treated as a concept with a unique process character, which is related to but different from accessibility and usability. So far, UD has been plagued by an understanding close to or confused with the definition of accessibility, not the least in policy documents. Thus, UD has often been evaluated and used prescriptively in similar manners to accessibility and usability. This is similar to Ryhl’s argument that “[...] disseminating universal design, direct or indirect, as a regulatory tool and agent of prescriptive requirements is against the original intent” [29,pp.265–267]. UD was originally conceptualised as being about societal attitudes, democracy, citizenship, equity, flexibility and social inclusion. Consequently, if UD at all should be evaluated, it ought to be done on the premises of how such factors are assessed and not based on operationalizations of accessibility and usability. Therefore, we propose using accessibility and usability to translate UD into practice and argue that all three concepts are needed. This requires developing the current understanding of accessibility and usability based on their respective definitions while acknowledging the principles, goals and values of UD. UD focuses on the basic principles of all design and

development in society, namely *that* the dignity, needs and requirements of all citizens must be considered. Accessibility and usability focus on *what* must be done and provide assessments and measurable data that are necessary for evaluation. There are two consequences of this reasoning: (1) nothing can be "universally designed" in a prescriptive, definite sense, and (2) it is not possible to evaluate to what extent an environment, product, etcetera, lives up to the values and goals of UD without considering accessibility and usability. That is, such evaluations are based on the definitions and operationalisations of accessibility and usability rather than of UD, which is primarily understood as a value-based vision and approach to design. Unburdening UD from operationalisations in terms of accessibility and usability creates space for questions regarding the evaluation of UD's impacts at different levels. This includes how UD influences societal attitudes, categorisations, and the way diversity is represented in design processes. It also opens up discussions on equity and stigma related to details like pictograms on signs and architectural elements such as "social staircases" [38,39].

Current status, tensions and suggested developments

While the three concepts accessibility, usability, and UD have different origins and are different per definition, the developments described in this paper point to an ongoing process of conceptual integration and harmonisation. For example, we observe a transition in the understanding of accessibility from a concept that relates only to persons with impairments to an understanding of accessibility based on process thinking in line with the guiding principles of UD, where all citizens are affected and targeted. Another example is that there is a tendency to apply UD not only to the construction of new but to the remodelling of existing environments and products as well, which is positive but even more demanding than the accessibility approach. This evolving shift challenges the original definitions of the concepts and creates a certain degree of uncertainty as well as a lack of clarity in the interpretation and application of them. Below, we outline some key aspects of the current status and tensions and highlight potential developments.

Insufficient accessibility and usability limit participation

A large body of research shows how insufficient accessibility and usability limit participation. For example, studying activities in playgrounds in the light of accessibility and usability, Prellwitz [40] showed that the physical environment limits opportunities for children with impairments to participate in play activities. This caused them to become dependent on parents and other children, leading to stigmatisation and restricted participation. Moore et al. [41] reviewed the literature regarding accessibility, usability and UD in the design of public playgrounds. They highlighted that working with accessibility requirements alone does not suffice to reach desired solutions and goals regarding participation and social inclusion. Accessibility is a key component, but there is a need to include usability and UD perspectives as well.

Another example of a multitude of factors in play and influencing participation is when navigating through different environments, such as during a shopping trip in an urban environment, which exposes the individual to obstructive as well as supportive aspects of the environments. Research about people ageing with spinal cord injuries has shown that certain accessibility problems at dwelling entrances are associated with perceived participation restrictions [42]. Among the oldest old as well, accessibility

problems in the home are associated with a lack of participation [43]. Research has shown that measures to remove physical barriers in outdoor environments can support the mobility of older citizens [44]. Furthermore, such measures have a positive effect on how older people experience accessibility and usability over time. Elucidating effects on usability, older people who rely on walking devices perceived that they encountered fewer barriers and had an increased level of outdoor mobility in the local neighbourhood, short-term (1 year) as well as long-term (10 years), in areas where measures had been implemented [45]. Thus, measures to remedy and remove environmental barriers have positive effects on accessibility as well as usability. Typically, housing adaptation rather target usability than accessibility [19], and numerous studies from different countries show the positive effects of such interventions [46–48]. Engagement in public policy debate has also proved to be important. For example, municipalities that issue policy decisions and establish accessibility plans have higher standards for accessibility and create a more positive climate for promoting accessibility [49]. Still, there is a knowledge gap in terms of the application of various regulations, documents and current legislation [50].

Consequently, persons with impairments are often required to navigate and manage environments that do not meet their needs. Bonehill et al. [51] described the emotional strain caused by attempting to adapt to accessibility and usability problems as well as the accompanying frustration, stress, and anxiety. They showed how environments can contribute to individual experiences of inequality when it comes to the physical prerequisites for participation, such as in urban environments. They argued that this inequality contributes to feelings of stigmatisation, fear, dependence, marginalisation, and discomfort.

However, accessibility and usability do not only concern persons with impairments. Slippery autumn leaves on bike paths and footpaths, holes in the ground on playgrounds, and difficult-to-read signs create difficulties and hazards for people of all ages and circumstances. Research focusing on accessibility in the national housing stock from a public health perspective highlighted that most of the available housing in Sweden does not meet the basic needs of the ageing population [52]. Accordingly, accessibility and usability are in the interest of the general population and not just a special interest for individuals, certain groups or population segments. This reasoning is one of the fundamental ideas behind UD.

Accessibility, usability, and UD are different concepts

The differences in conceptualisation constitute a key aspect that was only implicitly addressed by Iwarsson and Ståhl [1] but deserves explicit attention. If we zoom in on fundamental differences, we realise that the three concepts serve to complement each other through their starting points and foundations in different thought models and application fields. While accessibility has a long tradition of being measured or assessed, and usability captured with, for example, self-rating scales or interviews, the evaluation of UD as a value-based vision and approach to design is not as developed and well-established. Although sometimes criticised as a reductionistic approach compared to UD, standards and guidelines have been important drivers of accessibility, often addressing usability simultaneously. The complex nature of person-environment interactions, negative attitudes towards accessibility as a driver of costs, and as an obstacle to freedom and creativity in design, challenge the cross-sectoral collaboration is required [15]. Upholding the value of accessibility, we argue that

standards for the design of different types of environments are warranted for society to make progress towards the ambitious vision of UD.

One consequence of the prevailing definition of accessibility is that some groups are intentionally excluded (Figure 1). In concrete terms, this means that design guidelines apply dimensions such as the placement of handrails at entrances that exclude those that are too tall or too short to be able to use them. If the standard is changed – in one direction or another – the result will be that more, or fewer, people will be included, which affects their conditions for participation. This mechanism was illustrated in a study where Helle et al. [53] used empirical data for simulations demonstrating how large proportions of a sample of older people would be included or excluded if, for example, the standard for the height of a threshold was changed. In practical societal planning, however, shortcomings concerning the inclusion of “all people” can be resolved through alternative solutions. For example, attempts have been made to address the problem of handrail height by placing two parallel handrails at different heights at entrances, thus accommodating a wider range of body heights and positioning. Another example is a design of zebra crossings, which was agreed upon in Sweden between interest organisations of people with mobility and vision impairments, respectively, to satisfy their contrasting design needs.

The enduring tension and interaction between some, most, and “all”

As outlined earlier in this paper, the three concepts we are analysing are based on different thought models, which is often lost when using them in policymaking, practice and research. UD is explicitly based on a diversity mindset that encompasses “all people.” In contrast, while accessibility and usability also strive towards the widest range of people, they have limits, be it a contrast threshold value or an inclination degree, that delineate inclusion and exclusion at the individual and group levels. See Figure 1 and compare “all” on the upper line with the lower line, which is based on the distribution of functional ability in the population.

The relation between some, most and “all” people is not fixed. On the contrary, there are numerous examples of how the design and functionality needed for some users add value and simplify the experience of many more. This can be seen in how speech-to-text technology has become a part of the standard functionality of computers and smartphones. The better this technology works for those who need it the most, the better it works for everyone. The use of symbols without text simplifies the experience for people with cognitive impairments but also makes it easier for

those who have not yet mastered the language in the country they are visiting or recently moved to, etc.

The misleading separation between “accessibility for the existing” and “UD for the new”

While the introduction of the CRPD enhanced UD’s position, it also created conceptual unclarity by introducing a temporal distinction between existing and new artefacts as well as explicitly expressing that accessibility is the goal of UD:

A clear distinction should be drawn between the obligation to ensure access to all newly designed, built or produced objects, infrastructure, goods, products and services and the obligation to remove barriers and ensure access to the existing physical environment and existing transportation, information and communication, and services open to the general public [...] All new objects, infrastructure, facilities, goods, products and services have to be designed in a way that makes them fully accessible for persons with disabilities, in accordance with the principles of universal design [14,p.7].

The differentiation between new and existing environments, products, services, etc. can be interpreted as “accessibility for the existing” and “UD for the new,” which has some support in the original conceptual definitions. We argue that the distinction is misleading and unnecessary, and that attention to all three concepts is necessary in all processes simultaneously for existing as well as new environments, products, services, etc. However, the importance and weight placed on them will differ from case to case. For existing environments, products, and services, UD will sometimes not be feasible, but targeting the widest range of potential users and consumers (“all”) will challenge and inspire beyond persons with impairments as the sole target group.

Key demands and challenges related to the realisation of UD

The introduction and continued adoption of UD create several tensions and challenges. Below, we outline some key developments connected to UD, but also to accessibility and usability and a proposed conceptual harmonisation of the concepts.

UD places higher demands than current accessibility standards

Because current design guidelines and standards necessarily imply that the entire population will not always be included (Figure 1), the increasing impact of UD will likely influence the specifications of future requirements for the design of environments, products, services, etc. This is hardly a source of controversy at the conceptual level but becomes highly controversial when putting the definition into practice. Even if still seen as an obstacle by actors in the planning and construction sector [15], the higher demands on accessibility implied by the CRPD definition are in fact adequate if we look at the prevalence of functional limitations in the population, not least in the older population segments [11].

UD expands target groups to include “all people”

In the 40 years that UD has developed globally, it has proved a challenge to expand the scope beyond persons with impairments acquired earlier in life and the segments of the population that experience functional decline due to age-related diseases or ageing per se. The established practices in traditional work towards accessibility are firmly entrenched, and UD is often pulled into

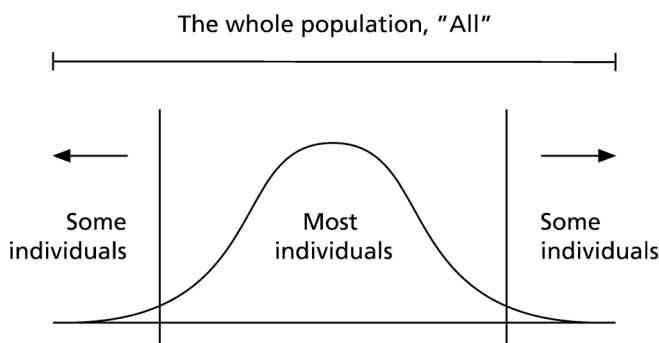


Figure 1. Illustration of the concept of accessibility relative to the distribution of functional ability in the population. Adapted from [54,p.297].

already established patterns. Among the hopes that are pinned to a proactive and innovative approach to UD is that “all people” truly will become the target group, no matter if participation is threatened for a parent who has to navigate in public transport with a stroller, a child, or a person with a disability acquired early or later in life. Challenging prevailing notions of human characteristics, UD efforts are based on intersectionality rather than dealing with functional capacity, cultural background, age, and gender as separate phenomena. As UD is gaining broader acceptance, it will be interesting to observe the ongoing shift in the understanding of who benefits from accessibility, usability, and UD to realise participation in life and society.

UD places higher demands on involvement and co-creation

Shifting to a UD-based development model the demands for determining who should be involved in the planning processes increase. Applying UD, people who experience marginalisation and restricted participation, that is, “the extreme users,” are of particular interest [55]. In the middle of the normal distribution curve in Figure 1, the design solutions are often simple, known, and sometimes even self-evident. In contrast, at the outer edges of the curve, where the difference between inclusion and exclusion is clearly visible, more knowledge, inspiration, and innovation are required. Challenging existing and dominant paradigms, it is, therefore, more efficient to make efforts targeting the outer ends of the curve where the strictest requirements are, rather than using the middle as the starting point [56].

Increasing the involvement of individuals and groups affected by the development of new physical environments, products, services, etc., is associated with participation. Since UD emerged, there have been several points of overlap with the human-centred design [33] approach. As the process perspective of UD has been further developed and given greater weight, co-creation has become an increasingly prominent and integrated component. Active involvement of persons with impairments is cited as a key to participation in the CRPD (see Articles 4.3 and 33.3), which means that the states undertake to involve, among others, the disability rights movement in processes that affect their interest groups. This means that the disability rights movement and other stakeholders are involved in the design processes as experts, for example, in the phases relating to idea generation and concept development, and when testing new solutions. Within urban planning, accessibility and usability efforts have historically had a certain element of co-creation through the establishment of “disability councils,” which were primarily tasked with tapping into the knowledge and experience of persons with impairments. Although the purpose of these councils was to provide opinions to inform the early stages of the design and planning processes, the general perception of those involved and those the councils reached out to was that their function was mainly to provide opinions on pre-determined solutions [57]. Establishing co-creation as the main *modus operandi* in, for example, urban development processes remains a key challenge to succeed with the continued realisation of UD [58].

UD demands a stronger focus on process

The process character of UD was described by Iwarsson and Ståhl [1] and further emphasised when Steinfeld and Maisel [31] introduced a definition explicitly highlighting UD as a process. However, further development and research are needed to develop valid methods to evaluate the effects of how accessibility and usability are implemented when guided by UD.

What voices are heard and what questions are raised in the early stages of development, when the design space is at its greatest, are decisive factors for the outcome, long before the effects on inclusion, exclusion, and participation are known. Determining which issues are important, when and at what level is a challenge faced by municipalities and others who intend to realise UD in urban development processes and other initiatives. It is noteworthy that planning and building projects with UD as a vision and all people as the target group often are marked by lacking UD values in the final results. The initial values get lost somewhere along the process from the early planning and design phases to the completed building or public environment [59]. Thus, there is a need for special attention to gaps between phases in the planning and building process, as well as to tensions and contradictions between different policies and guidelines, for example, between ecological and social sustainability [60].

The ongoing process of conceptual harmonisation

In the field of standardisation, there is an expanded understanding and greater focus on accessibility and usability, and the language involving accessibility and usability is coming closer to and more in line with the descriptions of UD. In 2018/2019, the European Committee for Standardisation (CEN) issued a new standard for how accessibility can be achieved through UD (EN 17161) [61]. This standard is based on a process mindset and addresses how organisations can work systematically to increase accessibility. Accessibility is defined as “the extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities, to achieve a specified goal in a specified context of use” [61]. This definition is based on ISO 9241-112 [13] and close to Mace’s definition of UD [36]. When the target group “all” is mentioned in this context, it is more in the sense of “almost all,” which can also be discerned in the definition of UD used in the CRPD. Further, Grue argued that the CRPD uses language limiting the state obligations, particularly regarding “undue burdens” [3, Article 2] related to reasonable accommodation. This leads to people with impairments having to continue what Grue [62] denoted as “invisible work” to take part in society.

With these shifts in language use, it is not surprising that accessibility, usability and UD are sometimes perceived as unclear concepts. People find the concepts confusing and complicated to grasp and translate into planning practices that really support participation “for all.” Continued critically constructive reflections, public debate, and scholarly attention are necessary to counteract further difficulties in the perception and interpretation of the three concepts, taken together as well as treated individually.

Accessibility, usability and universal design – key ingredients in a synergistic entity contributing to the conditions for participation

Based on our conceptual exploration and recent examples from policy and research, we present a harmonised model where the concepts of accessibility, usability, and UD are explicitly defined and closely connected, both with each other and with the conditions for participation. The model is applicable for individuals, specific groups, and the entire population and society. Looking ahead, we suggest using accessibility, usability, and UD as indivisible, complementary concepts in a synergistic entity, contributing to creating favourable conditions for participation for all (Figure 2).

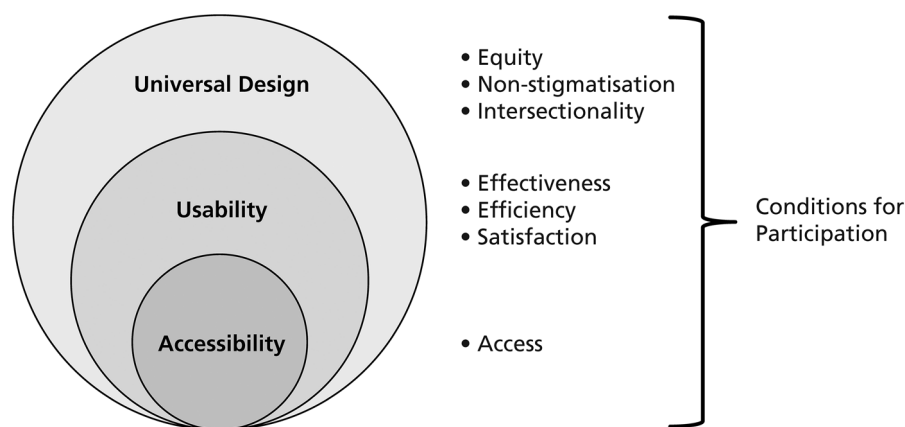


Figure 2. The three concepts – accessibility, usability, and universal design – with their focus areas and how they relate to the conditions for participation.

As we have shown, the concepts are not synonymous, have different foci, and are based on different thought models. Accessibility is at the core of the complex web that creates the conditions for participation and represents the first layer in Figure 2. Accessibility implies that society will provide measures, guidelines and standards as guidance for those responsible for planning, development and the provision of environments, products and services to ensure, at a minimum, that “most people” have access. At the individual and group levels, accessibility concerns personal conditions in a given situation and approaches usability, which is the next layer in Figure 2. Well-established in standardisation documents, policies and guidelines, usability highlights the subjectively perceived perspectives of environments, products, and services related to tasks people need, want and must perform. Usability has since long focused on efficiency, effectiveness and satisfaction, but today, the entire user experience is in focus.

UD is the third and outermost layer in Figure 2, which transforms the requirements for how a society needs to be designed, who needs to be involved in the work to create it, and which mindsets and values should guide such efforts. UD is the vision serving as the overarching concept, which complements the image of the interaction between people and the environment as a prerequisite for participation. UD creates a stronger emphasis on equity, non-stigmatisation and intersectionality, with involvement of a diversity of people in the design process as an important element supporting participation.

The three circles integrate to create optimal conditions for participation and should therefore be seen as essential components of a whole, where the inner layers are coloured by the outer layers. This means that when accessibility and usability are part of a UD approach when designing instead of being dealt with separately, the way they are implemented is guided by the value base in UD. The way the different concepts influence each other can also be described in the opposite direction, from the smallest to the largest circle. Something that is perceived as usable is likely also accessible, and what lives up to the values of UD usually has good usability and is accessible. With this harmonised whole established, it is important to highlight the importance of the individual if participation is to be achieved – accessibility, usability, and UD are necessary, but not sufficient, prerequisites. The extent to which an individual participates or not cannot be determined by external factors alone. Individual empowerment and experiences of being able to influence the external environment must be considered, as well as feelings of belonging and personal commitment. The presence of these conditions does not automatically realise participation. Ultimately, it is up to the individual to take responsibility for his/her personal participation, but

society has the responsibility to provide the prerequisites for the realisation of participation.

Conclusion

Revisiting a paper conceptualising accessibility, usability and UD more than 20 years ago, we conclude that conceptual ambiguity and confusion in policy and practice remain regarding the three concepts. Reflecting on recent policy developments, the CRPD has played a significant role in emphasising the importance of participation in all aspects of life. The Agenda 2030 has taken a broader approach, recognising inclusion and equity as essential, spearheading the goal of leaving no one behind. Describing and problematising the three concepts and their interrelationships, we conclude that there is a need to counteract conceptual slippages and uphold conceptual clarity. We present an argument that the concepts can be combined and harmonised as key ingredients in a synergistic entity: The *participation of all* is the ultimate goal of society. *Universal Design* is the value-based vision and approach to design grounded in human rights that, through intersectionality and involvement, should permeate all aspects of society to create the best possible conditions for participation for all citizens. *Accessibility* and *usability* are tools for operationalising and translating universal design into practice, applicable at the individual, group, and societal levels. Intended for implementation at all these levels, we propose a harmonised model where the concepts are explicitly defined and closely connected, both with each other and with the conditions to reach participation at scale.

Disclosure statement

A.S. and S.I. co-authored the original paper, which constituted the starting point for the present paper.

Funding

This work was financially supported by the Swedish Research Council for Health, Working Life and Welfare (Forte; grant 2016-07090), the Swedish Governmental Agency for Innovation Systems (VINNOVA; grant 2021-02810), and the Ribbingska Foundation in Lund.

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