

# JACCES

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## Journal of Accessibility and Design for All.

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## EDITORS' LETTER

Journal of Accessibility and Design for All emerges from the sum of the visions of both institutions, the Fundación ONCE and Universitat Politècnica de Catalunya-BarcelonaTech. It aims to be the meeting point between knowledge and social reality, offering a framework for discussion in which science and society could incorporate their needs and opportunities to ensure equal opportunities for all people through progress.

*A collection of thoughts must be a pharmacy  
where there is a remedy for all ills.*

Voltaire (1694-1778)

*Nothing is more evenly distributed than the  
reason: everyone is convinced of having enough.*

René Descartes (1596-1650)

*If you do not act as you think, you end up thinking  
how you act.*

Blaise Pascal (1623-1662)

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## STATEMENT OF PRINCIPLES

Editorial Team of JACCES

*'Looking for the good in our fellows, we can find ours'. Plato 427-347 B.C.*

*'There is a driving force more powerful than steam, electricity and atomic energy, the will'. Einstein 1879-1955.*

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The Society is an organized system, made up of a group of individuals who, characterized by a similar culture and ideology, interact and cooperate with each other so to achieve common goals, allowing this way that the people from this system could develop their life to the full. Its evolution, however, is intrinsically linked to the scientific findings, which, at the same time, are a base for the technological development and whose implementation have brought society to an exponential level of wellness and life quality.

Technology is then conceived as a 'social construct' (Tecnología y Sociedad, 1982), developed by society so to meet the needs it generates. However, in practice, most of the technological devices are designed to be used by most of the people in a community and not by all its members. This has led, and is still leading, a great proportion of people to social exclusion, whose abilities and needs to develop their vital activities in the community, are not taken into account.

It is true that, in the last few decades, the social consciousness has been raising and, together with the demands of certain society sectors, there have been contributions for improving the system deficiencies, favouring the equality of opportunities to the whole of the citizens. However, despite all these efforts, there is still long way to go.

Having this premise into mind, and thanks to the joint desire and effort of both the ONCE Foundation and the Accessibility Chair, it is born the Journal of

Accessibility and Design for All (JACCES). Its aim is becoming a catalyst for the dissemination and promotion of new technologies and developments on accessibility and design for all, so the society could evolve in line with the equality of opportunities to each and every person.

Therefore, JACCES pretends to collect all those advances and researches on accessibility and design for all related to a series of disciplines which are considered basic pillars in the society evolution and sustain: Engineering, Architecture and Construction, Health and medical care, Society and economy, and Education.

JACCES is a peer-reviewed journal with an international scope and its aim is to offer a non-profit journal with open and immediate access. For these reasons, the journal is published digitally as a main publishing way and so being able to offer knowledge and advances in the accessibility and design for all fields.

This way, JACCES aspires to be a nexus between communities, favouring the exchange of ideas, and also a referent in the accessibility and design for all fields. According to that, it intends to be a source of information for professionals, not only for the academic community but also for the public and private sector, becoming this way base and inspiration for new research, scientific contributions and devices which, sooner or later, will be part of the society, shaping it into a system capable of offering equality of opportunities to each person in it without any excluding condition.

# TOWARDS PHOTOVOLTAIC POWERED ARTIFICIAL RETINA

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**Abstract:** The aim of this article is to provide an overview of current and future concepts in the field of retinal prostheses, and is focused on the power supply based on solar energy conversion; we introduce the possibility of using PV minimodules as power supply for a new concept of retinal prostheses: Photovoltaic Powered Artificial Retina (PVAR). Main characteristics of these PV modules are presented showing its potential for this application.

**Keywords:** accessibility, artificial retina, PVAR.

## Introduction

The number of cases of vision loss due to age, birth or accident, is increasing, in particular the dystrophies of the retinal photoreceptors, such as retinitis pigmentosa (RP) and macular degeneration (AMD), resulting in blindness for a significant number of people as described by Curcio, Medeiros and Millican (1996) and Humayun (2001).

The International Classification of Functioning, Disability and Health (ICF), established by the World Health Organization in 2002, is a universal classification of disability and health for use in health and health-related sectors. ICF implied a radical change because the stress shifted to health and functioning rather than on disability and illness. According to this new viewpoint, there were defined three domains, from body, individual and societal perspectives. This allows a holistic approach that includes both the level of capacity of the body and their level of performance in their usual environment in a social context.

Disability therefore involves dysfunctioning at one or more of these same levels: impairments, activity limitations and participation restrictions. Impairments are the problems in body function or structure such as a significant deviation or loss. Activity limitations are difficulties an individual may have in executing activities. Participation restrictions are problems an individual may experience in involvement in life situations.

Accordingly, this research is focused on finding a technological solution in the body level, specifically for retinal impairments, in order to mitigate the limitations of the visual activity. Obviously this would have an impact in the social participation of people with retinal dystrophies because their restrictions will be removed. Patients could benefit from a major independence, mobility, safety and in general, best quality of life. This is our final aim. Laser treatments described by Bressler (2001) have been identified as effective in treating macular degeneration in some cases and the research by Del Cerro (1987) and Accland (2001) indicates that retinal transplantation and gene therapy respectively, potentially can reverse visual loss caused by retinal degeneration. However the hereditary dystrophies of the retinal photoreceptors are still untreatable, leading to blindness.

Tassiker et al in 1956 showed for the first time the use of a semiconductor sensor behind the retina of a blind patient that was able to transiently restore the patient's ability to visually perceive light.

Autonomous, implantable biomedical devices are primal goal in many areas of health care, as the treatment of some illnesses, and could be done in a more economically viable manner. This line of research, therefore, is applicable and useful for other artificial implants.

The state of the art of implantable bio-medical devices relies heavily on customized design and fabrication to provide flexibility, energy transfer and protection against the electrophysiological environment of the body. These specially tailored products require long time and clearance of regulatory issues, thereby dramatically reducing the competitiveness of commercial initiatives. As

in any other application field, the device performance is compromised to meet the requirements of available technologies.

We describe in this work the main antecedents of retina implant experiences and we also estimate the potential of Photovoltaic Powered Artificial Retina (PVAR) devices. PVAR aims to produce autonomous, miniature, implantable bio devices, using photovoltaic conversion.

### **Photovoltaic Powered Artificial Retina (PVAR)**

Several research groups have investigated on retinal prostheses, from electrical stimulation of retinal neurons to surgical implantation methods (Eckmiller, 1997; Chow & Chow, 1997; Rizzo & Wyatt, 1997; Humayun, 2001).

The most followed approach is to use electrical stimulation of parts of the visual system undamaged, by means of microelectrodes. Microelectrodes have been used in two configurations: subretinal and epiretinal.

The epiretinal approach (Eckmiller, 1997; Humayun, 2001; Rizzo & Wyatt, 1997), incorporates electrodes on the ganglion cell side of the retina and no light-sensitive elements are used. The epiretinal implant is a chip receiving electrical signals from a distant camera and processing unit (Dogulas Yanai et al. 2007; Veraart C. et al. 2003; Humayun et al. 2003). The implant generates electrical pulses conveyed from the optic nerve to the brain.

In the case of subretinal approach however (Chow & Chow, 1997; Zrenner et al., 1997), the electrodes are placed in between the retina and the retinal pigment epithelium. Light-sensitive microphotodiodes equipped with microelectrodes are placed in the subretinal space between the pigmented epithelium and outer layer of the retina. The light incoming on the retina generates currents in the photodiodes which activate the microelectrodes, resulting in stimulation of retinal sensory neurons.

In few examples, such as in Chow et al. (2001) the energy required is coming from the incident light, whereas in most of the cases an external source of energy is required. Among the several means to provide this extra energy,



experiences with wiring and more recently (Mokwa 2011) with RF-coupling using an inductive link, directly placed in front of the eye can be found.

Complex microelectrodes are also required made of inert materials, in a sufficient number. Moreover the charge injection by the microelectrode to excite retinal neurons is critical (Margalit et al. 2002).

Visual perceptions depend on the main parameters of the stimulation signal such as the amplitude and duration among others.

In vivo experiments (Weiland et al. 1999) revealed that current threshold can be in the range of 100-600  $\mu\text{A}$  and charge density of 0.8 to 4.8  $\text{mC}/\text{cm}^2$ . An idea of the size of the implants experimented, is provided by the work of Chow et al. (2004) who were able to include up to 5000 microelectrodes in a 2 mm-diameter silicon based device.

PVAR can accomplish the main requirements of subretinal implants, as providing extra energy more electrodes could be implanted with enough power. PVAR has a great potential in this application as it has been show that smart miniature PV modules can be made flexible and can be encapsulated using bio-compatible materials. Furthermore this idea is compatible with embedded integrated circuits and sensors to provide computational sensing and communication capabilities. PVAR novelty is therefore twofold: no need for bulky inductive components, and modularity of the power supply.

### **Mini PV minimodules**

Miniature photovoltaic (PV) modules have been developed at the group of Micro and Nano Technologies of the Electronic Engineering Department of the UPC, as power supply (Ortega et al. 2008).

The PV minimodules, having an area in the range of 0.5  $\text{cm}^2$ , consist on an array of individual photovoltaic cells connected in series to fulfill the voltage required by the application. The photogenerated current is proportional to the individual solar cell area.

The fabrication process steps starts with a commercial Silicon-On-Insulator (SOI) c-Si p-type <100> wafers. A SOI wafer consists on an active p-type layer, of small thickness (5 and 10  $\mu\text{m}$  in our devices), on top of a handle wafer, 400  $\mu\text{m}$  thick, which acts as mechanical support; in between the active layer and the handle wafer there is a buried oxide layer of approximately 1  $\mu\text{m}$ . The top active layer is where individual solar cells are fabricated and they are isolated from each other by means of trenches anisotropically etched. Emitter and base contacts of the photocells are both in the front side of the wafer, making easy the series interconnection of cells performed by metallization and patterning (Figure 1).

Different PV minimodule Topologies of 9, 25, 49, 81 and 169 cells in series have been fabricated (Figure 2). Average electrical results of open circuit voltage,  $V_{oc}$ , short circuit current,  $I_{sc}$ , and maximum density power,  $P_m$ , are shown in Table 1. The results are an average from 3 up to 5 measured devices.

*Figure 1. Cross section showing interconnection of solar cells forming the PV minimodule.*

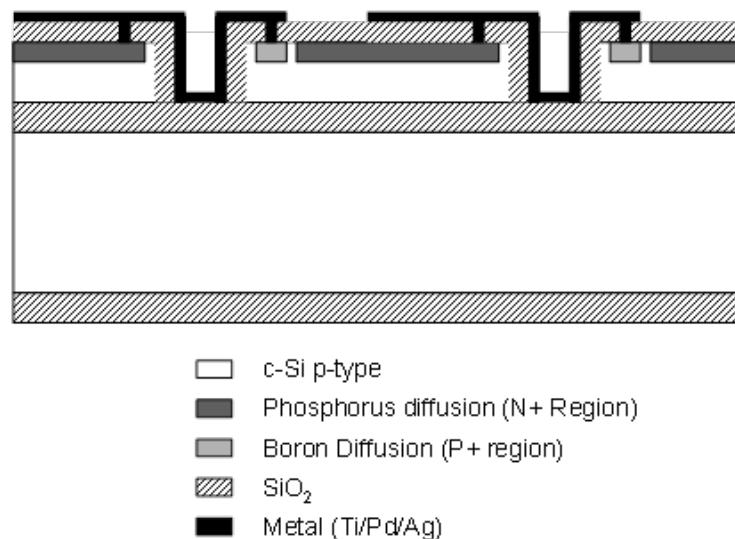


Figure 2. Photovoltaic minimodules of 9 (a), 25 (b) 81 (c) and 169 (d) cells in series.

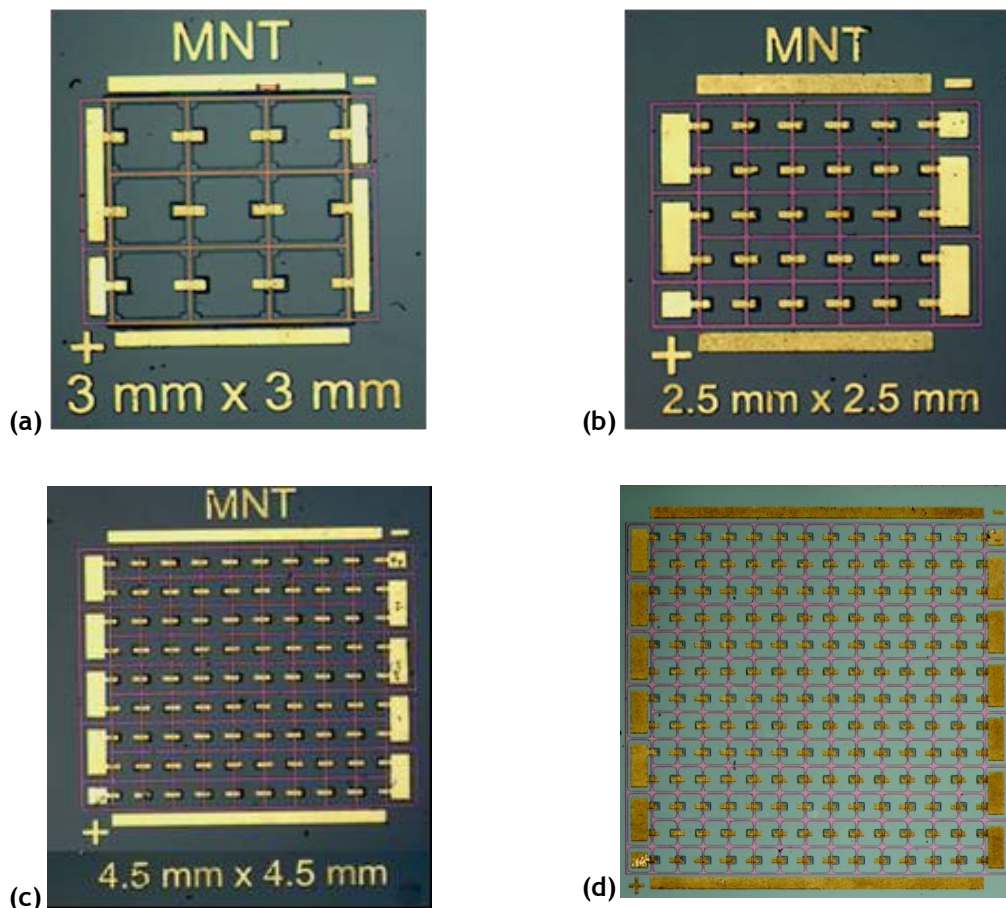


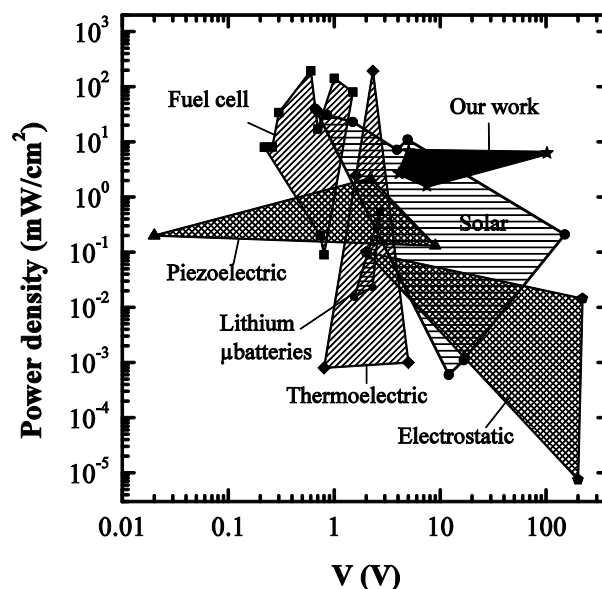
Table 1. Main electrical characteristics of the PV minimodules

Number of solar cells	$V_{oc}$ (V)	$I_{sc}$ ( $\mu A$ )	$P_m$ (mW/cm <sup>2</sup> )
9	5.6	200	4.1
25	15.7	179	4.9
49	30.3	194	6.7
81	47	42	6.7
169	71.6	43	3.0

The output power of the PV minimodules can be flexibly adapted to cover different ranges, adjusting conveniently output voltage and current, thanks to the interconnection technology of the solar cells forming the PV minimodule developed by the MNT. This allows the application of these PV minimodules as power supply to a wide range of low power applications having different requirements, including high voltage applications, and especially to the PVAR.

The availability of power density offered by the PV minimodules outperforms most of competing power generation technologies nowadays on the market (Figure 3) and covers typical power requirements of main retina implant techniques described in the literature.

*Figure 3. Comparison of power densities available from different technologies used as power supply.*



## Conclusions

Mini photovoltaic modules, based in a new interconnection technology of high efficiency solar cells fabricated at the MNT of the UPC, have been introduced. The characteristics of these PV minimodules, in terms of area and power, have been discussed showing their potential as power supply for a new approach in the field of retinal prostheses, the Photovoltaic Powered Artificial Retina (PVAR).

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## CAPABILITIES AND ACCESSIBILITY: A MODEL FOR PROGRESS

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**Abstract:** Accessibility is seen to be a core issue which relates directly to the quality of life: if a person cannot reach and use a facility then they cannot take advantage of the benefits that the facility is seeking to provide. In some cases this is about being able to take part in an activity for enjoyment, but in some it is a question of the exercise of human rights - access to healthcare, education, voting and other citizens' rights. This paper argues that such an equitable accessibility approach requires understanding of the relationships between the capabilities that a person has and the capabilities required of them by society in order to achieve the accessibility they seek. The Capabilities Model, which has been developed at UCL is an attempt to understand this relationship and the paper sets out an approach to quantifying the capabilities in a way that allows designers and implementers of environmental construction and operation to have a more robust approach to their decisions about providing accessibility.

**Keywords:** Accessibility, Biomechanics, Capabilities, Modelling, Multisensory perception.

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### Introduction - Models

This paper argues that in too many cases the issue of accessibility is seen as a problem for people with mobility deficits, rather than as an opportunity for society to ensure that quality of life is maintained. Yet it is not only a duty for society. Each person also has a responsibility to act in a way that ensures that the burden of accessibility is spread fairly and that all benefit from equitable access. This is a shift from the so-called 'social model of disability' coined in



the late twentieth century to follow the previous 'medical model' in which disability was emphasised as something to be cured or treated.

Especially in the case of younger disabled people (often with disabilities caused by trauma as a result of military action, traffic accidents etc. rather than with underlying medical conditions), the question of treatment was secondary to the question of how they were going to arrange their new life in order to maintain the quality of life to which they had previously aspired. As a result, the concept of the role of society in disability became more apparent; treating the disability was simply dealing with the symptoms of the problem and left the core issue - the inability of society to design an environment which could accommodate disability - untouched. It is this call on society to play a more active role that became the nub of the 'social model' - "I am not disabled, Society disables me by its inability to accommodate my needs". This is all very well, but it also fails the individual: neither the medical model nor the social model considers the actual relationship between the person and their immediate environment and thus neither will provide a realistic approach to determining what should actually be done, either in terms of treatment or therapy or in terms of (re)design of the environment, to make the situation better for the person.

To return the person to the centre of the opportunity to improve their quality of their life, we started to consider what actually comprises the relationship between a person and their immediate environment. Starting in a very simplistic way, we considered elements of the environment that could be changed and the thresholds at which change could yield a significant change in outcome. The width of a ticket gate at a metro station, for example, could preclude some people from using the metro system as a whole (Cepolina and Tyler, 2004). It soon became clear, however, that in order to make a usable model - one which could help people design and use a more accessible environment - we would need to understand a lot more about capabilities. This paper aims to set out where we have reached in this task.



First, we will set out the Capabilities model in a little more detail in the next section. Section 3 will then describe how this has been applied in two example cases and Section 4 will discuss these outcomes and what the next steps will be.

## The Capabilities Model

### The core elements of the Capabilities Model

The Capabilities model consists of three core elements:

- The person wishing to undertake an activity;
- The activity the person wishes to undertake;
- The environment which needs to be encountered in order for the person to undertake that activity.

#### The person

The person is considered to be the centre of the model. They present themselves with a desire to undertake an activity which takes place in a given place and with their own set of capabilities which are relevant to the activity and the place. In many cases these capabilities are measurable (strength, for example, or the ability to raise a leg above a certain height, or a certain level of visual acuity) and we call these capabilities 'Provided Capabilities' to indicate that these are what the person brings to the issue on the day and at the time required. Provided Capabilities are personal to the individual and can change at any time.

#### The activity

The activity is the set of tasks the person wishes to undertake. These tasks are made up of a set of actions which require certain capabilities on the part of the person in order for the tasks to be completed. Buying a newspaper is such an activity. It will require the ability to choose the correct newspaper and deal with the money transaction in order to buy it. This suggests that there is a need to have a capability to choose, to deal with money, and maybe to reach out and pick up the newspaper from the shelf in the shop. These are capabilities that

are required by the activity of buying a newspaper and we call them 'Required Capabilities'.

### The environment

Buying the newspaper could require other tasks such as walking along the pedestrian footway, crossing a road, entering the shop, dealing with money and so on. To take one example, 'crossing a road' requires a set of actions such as looking each way to detect oncoming traffic, being able to calculate a moment when it is safe to step into the carriageway, being able to step off the footway onto the road surface, being able to walk across the road, and being able to step up from the road surface onto the footway. The other tasks can be broken down into actions in a similar way. Each action requires a set of capabilities on the part of the person before they can successfully complete it and so the task - and eventually the activity - requires a set of capabilities of the person in order that they can successfully achieve their desire. These are also 'Required Capabilities', although they pertain more to the environment in which the activity takes place, including the means of reaching the activity. Required Capabilities indicate that these are levels of capability that need to be provided by the person if they are to achieve the activity. The overriding point is that in order to buy the newspaper, the person will have to be able to provide sufficient capabilities to counter the capabilities required by the activity itself and the environment.

It is important to realise that the activity could be achieved in a number of different ways, each of which could have a different set of Required Capabilities, and so a person whose Provided Capabilities are insufficient to achieve the activity in one way might well be able to assemble sufficient Provided Capabilities in order to achieve it in another. This is known as the 'Coping Strategy'.

## The model process

In very simple terms, the Capabilities Model compares Required and Provided Capabilities in respect of the activity at hand (or some task/action within the activity) and the resulting comparisons show where an intervention might be required in order to increase the accessibility of the activity.

For example, it might be impossible for a person to catch a bus because the timetable is printed in a font which is too small for them to read. The intervention could be to increase the size of the font in the timetable, to introduce a new aural timetable service - thus changing the Required Capabilities - or it could be to provide the person with corrective spectacles or other eye treatment to enable them to read the font in its present size - thus changing the Provided Capabilities. Deciding which should be done is a matter of making a decision on the basis of the knowledge about the capabilities and how these spread across the population, the feasibility of amending the format of the timetable or introducing a new service or the reality of the prospects of treatment. Knowing where the problem is provides a good start for considering these issues in a knowledge-based way rather than simply assuming that one or the other is the only way to solve the problem.

The key is therefore to know how to measure the capabilities. We now discuss two examples where such a consideration could be helpful.

## Capabilities Examples

We now consider two examples: one relating to vision and one relating to wheelchair propulsion.

### Vision

In 2008, as part of the culmination of some 15 years of work to develop a gene replacement therapy for Leber Congenital Amaurosis, evaluation experiments were required in order to show the efficacy of the therapy (Bainbridge et al. 2008). It was important to show that the therapy was not just delivering an improvement in eyesight, but that this improvement would be meaningful for

the person in terms of improving their quality of life. The research team from the Institute of Ophthalmology (IOO) approached the Accessibility Research Group at UCL to set up some before-and-after experiments to test where the therapy was able to deliver such an improvement. Accordingly we worked with the IOO research team to design a set of experiments in our laboratory (the Pedestrian Accessibility and Movement Environment Laboratory - PAMELA) where we could set up street environments under different controlled lighting conditions. The results are reported in Bainbridge et al. (2008), but put simply, they showed that at a lighting level similar to that found in residential streets in suburban areas in the UK (about 4 lux at ground level), the participant who, in the before study had progressed through the maze in 1 minute 20 seconds, with several collisions with the walls of the maze and two complete disorientations, was able after the administration of the treatment to complete the maze task with no collisions and no disorientations in 17 seconds. Why is this important and what does it mean for the Capabilities Model?

It is important because the improvement in the patient's eyesight meant that he could now see well enough to be able to go out at night and to play his guitar with his friends without the need to have his parents present to guide him along. From the perspective of the Capabilities Model, it is an example where, in this case the comparison between the medical treatment and the alteration of the lighting levels yielded a solution through a change in the Provided Capabilities - the lighting levels remained the same in his residential street, but his capability to deal with them had been changed. What the Capabilities Model did on this occasion was to show the research team that simply testing the medical benefits of the therapy was not sufficient to tell what the actual benefits to the person could be. If the therapy had not delivered this outcome, would it have been worth pursuing further?

### **Wheelchair Propulsion**

Nearly every footway in the world has a transverse slope (called a crossfall) to facilitate drainage. According to engineering practice and a number of standards, the crossfall should have a gradient of approximately 2.5%. Many do

not comply with this standard - partly because it is relatively difficult to lay a surface with such a precise transverse gradient, partly because it is believed that, for drainage, if there is to be an error it should be to increase, rather than to decrease, this gradient and partly because over time, vibrations from local traffic, changing weather, soil settlement and so on, the footway settles to provide a steeper gradient.

Holloway (2011) set out to examine this issue to see if this presented a problem for wheelchair users.

To propel a wheelchair along a transverse slope requires not only the force required to move the physical mass of the wheelchair and its occupant, but also to compensate for the gravitational forces which tend to force the wheelchair down the slope. This compensation can be provided in a number of ways and the opportunities and challenges are different depending on whether or not the wheelchair is being propelled by its occupant or an attendant.

In general terms, to keep the wheelchair travelling in a straight line on a transverse slope will require additional force to be applied to the side which is lower on the slope (the 'downslope side') and relatively less force to be applied to the other side (the 'upslope side'). This can be applied, for example, through lots of small pushes on the downslope side relative to the upslope side, or a few large strong pushes on the downslope side. The difference of force could also be applied though braking on the upslope side of the wheelchair also requires different forces to be applied to the downslope and upslope sides. In all, although while the amount of work done to propel the wheelchair (i.e. the force applied over a given distance) remains constant regardless of crossfall gradient, the presence of a crossfall means the wheelchair user must have a second provided capability to produce the difference of work needed to counter the effect of gravity is considerably more on a crossfall than on a flat surface. The Capabilities Model recognizes this as an increase in the Required Capabilities - both in terms of having the strength required to provide this larger force overall and also the capability of being able to apply a different

force on each side at the same time and also there is some sense of needing some form of coping strategy.

The second case is the wheelchair which is being propelled by an attendant. This is different from the self-propelled case just discussed because the attendant is in constant pushing contact with the chair (the wheelchair occupant supplies intermittent pushes via the hand rim on the wheel, thus there are periods when there is no pushing contact with the chair). The force and work issues involved are as before as the core issue is the propulsion of a given mass along a given distance on a given surface at a given crossfall gradient, but in this case the continuous nature of the push and the fact that in effect these are being delivered by one arm makes increases the work - and the control - required to move the chair rather more difficult. In fact in some cases the force required of the attendant exceeds the legal limits for pushing within the UK's Health and Safety legislation.

In both cases, the problem becomes worse as the crossfall gradient is increased.

Holloway (2011) showed that measuring the forces required to move the wheelchair yielded a quantified version of some of the Required Capabilities. The force transducers, whether applied to the wheel or the push-handles, measured the forces required at those points to overcome the gravitational forces and inertia acting on the chair and its occupant. They did not measure the work actually put into delivering those forces at that point. It was evident that there some force is applied downwards on the handle, and the extent to which this is useful in terms of propulsion or stability is an interesting question to explore. We could also expect that there could be some loss of output as a result of flaccidity in joints and muscles which mean that the amount of force put in by the occupant or attendant is greater than the forces actually required to move the chair as required. This is work that remains to be done.

Considering the Capabilities required to respond to the crossfall gradient helps to determine the extent to which current standards are appropriate, whether it would be beneficial to exert a more strict control over construction and design,

or whether we should be seeking to deal with drainage in a different way - one that does not require crossfalls. Or, should we be seeking to develop technology to assist the wheelchair user (occupant or attendant) in propelling a wheelchair along a transverse slope? What the Capabilities analysis shows is that crossfalls are a problem for people in wheelchairs and one that does limit their ability to undertake the activities they would like to achieve. The likelihood is that it would be easier in this case to address the problem of assisting wheelchair pushers to handle transverse gradients rather than change all the crossfalls in the world, but that a suitable approach to standards would help to reduce the problem in the long term.

## Discussion

The two examples described above show that the Capabilities Model is a useful way of comparing the relationship between a person and their immediate environment and considering whether improvements to quality of life might be delivered by changes to one or the other. The Capabilities Model is a way to look at the environment through the capabilities of the person trying to interact with it while simultaneously looking at the person themselves to see what they can achieve.

The key problem at the moment is how to measure the capabilities. The examples discussed here suggest that one way to do this is to use Provided Capabilities as a means of finding out what the Required Capabilities are. However, this needs a comprehensive evaluation of the 'capability losses' within the person that indicate that the person is being required to put in more effort than is actually required in order to deliver the Required Capabilities.

Although the two examples considered here both relate to a person and their interaction with the physical environment, they are otherwise different. One involves the sensory perception of the environment whereas the other is much more involved with the physical response to the environment. However, they can both be considered with the Capabilities Model and this gives rise to two thoughts.

First, the usual situation is that accessibility involves a test for more than one type of capability (dealing with a gradient and poor visual perception at the same time for example). So how do we work out what the Provided Capabilities are in cases where multiple capabilities are required, what are the issues in terms of coping strategies and how do we measure these? By assessing the capabilities compared with the achievement of a single outcome - achievement of the activity, for example - we are already combining the capabilities in one sense. However, should we be measuring the capabilities independently of the task in question and then determining which are core to the activity, and thence which are the crucial elements in determining the accessibility of the activity? An example of this could be how we determine where it is safe to walk in a street environment. It is a combination of cues - visual, hearing, balance, tactile, experience, and so on - that tell us where we are in relation to vehicles. Reducing or removing one of these places a stronger need on the information yielded by the others, but the actual information is still obtained from a combination of cues. Can Capabilities model this type of interaction?

Secondly, how do we rate capabilities in comparison with each other? The question is whether there is some notion of 'capability' that is independent of the actual ability being considered, and which could therefore yield a quantifiable objective measure that would enable us to compare directly the benefits that could be gained by acting in different ways to improve the situation for people with different disabilities.

## Conclusions

This paper has described the Capabilities Model being used in our search for an equitable way to develop a more accessible society. We have discussed two examples in which the consideration of capabilities has enabled us to think about quantifying what is meant by accessibility and how we might ensure and check delivery of an accessible society through a combination of changes to the environment in which we live and the treatments and therapies that will continue to be developed and become available to us in the coming years.



We conclude that it is possible to determine ways of measuring capabilities, but that there are still questions to be asked, in particular about the details of measurement and in the combination of capabilities.

Nevertheless, the Capabilities Model does provide a coherent and objective basis on which to consider the accessibility performance of infrastructure and environment design.

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## THE PROSPECTS FOR UNIVERSAL DISABILITY LAW AND SOCIAL POLICY

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**Abstract:** The worldwide disarray of disability social policy and law requires a new foundation to make it coherent and to remedy persistent contradictions, disincentives and other policy anomalies. In this paper we clarify and expand Irving Zola's call for 'universalized disability policy' and develop his insight by drawing upon the well-known principles of Universal Design (UD), or Design for All, in architecture, product development and city planning to formulate analogous principles of universally designed disability social policy and law. Our objective is to show, by means of two examples - one in health care delivery and the other in welfare or social support policy - that 'universalized' policy for and on behalf of persons with disabilities is feasible. We find that there are some, albeit limited, examples of universalizing policy in these areas and suggests ways in which the full range of UD principles might be able to be implemented in these two policy areas. What we propose is merely a proof of concept rather than a complete proposal to restructure disability law and policy - which likely not be feasible, given the range of social and economic conditions of countries around the globe. We conclude with some tentative suggestions for areas of empirical research that would further the overall agenda of a universal disability social policy.

**Keywords:** universal design, disability policy, disability law, minority group approach, welfare.

## Introduction

Social policy and law for, and on behalf of persons with mental and physical disabilities is in disarray, worldwide. In part, this is a result of the extraordinary diversity of disability policy and law. In most developed countries, besides basic human rights or anti-discrimination law, one can find relevant pockets of policy and law addressing disability issues in medical and rehabilitative services, long-term services and supports for individuals and families, institutional care, independent living, income security, health and safety legislation, compensatory accident and unemployment schemes, as well as policy regarding employment, education, housing, communication, transportation, assistive technology, data collection and research. This is an enormous array of programs and it is understandable that coordination would be an endemic problem. But the disarray has deeper roots (see Bickenbach, 2011).

There is a persistent gap between expectation of the objectives of policy and law and the actions taken to implement them. There is also a lack of consistency and coordination that results in ad hoc and 'add on' social programming and a generally reactive legal response to disability issues (Stone 1984; Bickenbach 1993). Disability policy is rife with disincentives, lack of accountability and an apparent lack of political will to put policy and law on a firmer footing. In developed and developing countries alike and in every area of law and policy there are glaring anomalies and inconsistencies; there is also a dilution of purpose and ambiguity of aim.

This has been known for some time, and a variety of explanations have been offered. Most of these explanations point to a lack of understanding of what disability is (and what it is not). A consensus has developed that disability is a complex phenomenon, at least in part socially constructed, and in any event not in any straightforward sense a discrete attribute of a person. Disability, most researchers now agree, is a collection of outcomes of social and other environmental interactions with mental and physical health conditions (WHO, 2001). We might call this the 'new paradigm' of disability, or even the received view of disability: this approach has been adopted in the United Nations

Convention on the Rights of Persons with Disabilities (UN, 2006: Preface; and see Leonardi et al., 2006).

But if there is consensus about the concept of disability in the social sciences and disability studies, there is far less agreement in disability law and social policy. In these domains, internal debates about conceptual approaches to disability are more entrenched. Moreover, the only likely candidate for a common language of disability in social policy and law is that provided by economics, which is no reason to be optimistic: economic theory insists that disability is a social cost that must be minimized in order to achieve cost-effectiveness, a view opposed, not only to the new paradigm of disability and its underlying human rights perspective, but also to the political aspirations of persons with disabilities for social equality and full participation.

In this paper we begin by clarifying an insight first suggested by Irving Zola's called 'universalized disability policy' (Zola 1989). We propose to develop Zola's insight by drawing upon the well-known principles of Universal Design (UD) in architecture and planning in order to formulate analogous principles of universally designed disability social policy and law. We will develop policy and legal analogues of the UD principles and sketch out two examples of universal law and social policy. Our primary objective is to show, by means of these examples, the feasibility of universal policy and law. We conclude with some tentative suggestions for areas of empirical research that would further the overall agenda of a universal disability social policy.

### **The idea of Universal Design**

According to an early characterization by Ronald L. Mace, UD means, "designing all products, buildings and exterior spaces to be usable by all people to the greatest extent possible." (Mace et al. 1991: 195) Designing products and environments (tools, homes, and entire cities) for maximum usefulness requires taking into consideration the full range of capacities that people have. UD, in other words, "respects human diversity and promotes inclusion of all people in all activities of life" (Story et al. 1998).

Universal design promotes integration across the range of human life, and potentially for every area of life in which people participate. Designers are advised to design for all people, and to do so must acknowledge disability, the manifestations of aging and other differences that constitute the range of human variability. Human beings have diverse repertoires of abilities; so while it is true that we are living longer and surviving injuries and illnesses, UD is not a response to some new demographic trend. It is a realization of the range of human normality that has always been with us.

Most commentators are quick to point out that UD is very different, in spirit and consequences from another general principle of design easily confused with it, namely barrier-free or accessible design. Barrier-free design originated in the 1950s as a response to demands by disabled veterans and advocates for people with disabilities to create opportunities in education and employment rather than relying on institutionalized health care and maintenance. In particular, physical barriers were recognized as a significant hindrance to people with sensory and mobility impairments in all areas of their lives. In the U.S., national standards for barrier-free buildings were proposed in 1961 by the American Standards Association (later known as The American National Standards Institute), which published the accessibility standards which, through the offices of the International Organization for Standardization, have been adopted internationally (see, ANSI, <http://webstore.ansi.org/default.aspx>).

Like the so-called “special needs” approach - which unfortunately remains the default design principle governing assistive technology - barrier-free design was motivated by the aim of increasing the extent to which people with disabilities could participate in areas of human life, from personal maintenance and family life to education, employment and community activities. Yet, designing products and environments for specific populations create products with a stigmatising medical or technical appearance. These products are frequently more expensive, harder to find, unreliable and difficult to repair.

Early on, many advocates of barrier-free design and architectural accessibility recognized the power of the notion of addressing the common needs of all

people, with and without disabilities. After all, many of the environmental changes needed to accommodate people with disabilities could benefit everyone. Hence the goal of addressing the full scope of human accessibility and creating products and spaces accessible to and usable by all people to the greatest extent possible. Disability-accessible design tended to produce separate facilities for people with disabilities (a ramp set off to the side of a stairway at an entrance or a separate, wheelchair-accessible toilet stall); UD advised designers to provide one solution that can accommodate people with disabilities as well as the rest of the population.

UD is therefore adaptable not (merely) accessible design. An adaptable dwelling unit has all accessible features that a fixed accessible unit has but allows some items to be omitted or concealed until needed so that the dwelling units can look the same as others and be better matched to individual needs when occupied. Similarly, a UD product or tool is one that is easily adapted for use by people of different ages and abilities, not one that is purposively built to be useful for a specified ability level, or, at the other extreme, designed for a 'normal' population that excludes those who fall outside of that arbitrary range.

In Europe, Universal Design is more frequently referred to as 'Design for All' and, like the US, it has been mandated, either explicitly or implicitly, in an ever-increasing number of policy areas by legislation. The European Institute for Design and Disability (EIDD) was originally established in 1993 to promote UD principles, changed its name to EIDD-Design for All Europe which now has active membership from 22 European countries. UD principles are enunciated in national legislation of most European countries, such as Ireland (Disability Act, 2005), Italy (Law 1 March 2006, n. 67), and in France (Loi n° 2005-102).

In the US, Section 504 of the Rehabilitation Act, 1973 implicitly adopted the UD perspective, as did the original Education for Handicapped Children Act, 1975. The Fair Housing Amendments Act, 1988, and accessibility guidelines issued by the U.S. Department of Housing and Urban Development in 1991 furthered the spread of the UD principle in housing.

In the developing countries, the same trends that motivate UD also obtain; but in these countries the need for UD is arguably greater since specialized assistive technology is much more costly and harder to find, and the stigma of disability can be much greater. In these areas of the world UD is an obvious alternative to accessible design since it can be more generally available at lower costs than specialized products or environments (WHO, 2011).

In the hands of creative designers and planners, UD has proven itself in many contexts. Of course, the challenge of making products and environment that can 'forgive' physical differences or adapt to a wide range of capacities, while not having a medical or institutional appearance and be marketable is not an easy challenge to meet. UD demands a sensitivity to and understanding of the broad range of human abilities throughout the lifespan. This sensitivity is guided by the seven principles of UD.

### **Principles of Universal Design - analogies for law and policy**

In order to evaluate existing designs and to provide a format for the design process, the founders of UD set out seven principles, each with guidelines (Story et al., 1998). Together these represent the first level of operationalization of UD. Although they were not intended to be used in this manner, the first five of these principles are, with modest alteration, directly applicable to the design of universal policy and law (table 1).

The first two principles contain the primary message of UD, namely that product and environment design should be equitable (Principle One) in the sense of being useful for people with diverse capacities (Principle Two) and flexible, in the sense of accommodating a wide range of individual preferences and capacities. Equitable use, the guidelines tell us, means that whenever possible the manner in which the product or environment is used should be identical or at least equivalent, and no user should be, by virtue of the design, segregated or stigmatized. Use is flexible when choice in method of use is provided, consistent with each user's abilities, pacing and preferences.

Table 1. The principles of Universal Design- Story, et al. 1998

<p><b>Principle one: equitable use</b></p> <p>The design is useful and marketable to people with diverse abilities.</p>
<p><b>Principle two: Flexibility in Use</b></p> <p>The design accommodates a wide range of individual preferences and abilities.</p>
<p><b>Principle three: Simple and Intuitive Use</b></p> <p>Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.</p>
<p><b>Principle four: Perceptible Information</b></p> <p>The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.</p>
<p><b>Principle five: Tolerance for Error</b></p> <p>The design minimizes hazards and the adverse consequences of accidental or unintended actions.</p>
<p><b>Principle six: Low Physical Effort</b></p> <p>The design can be used efficiently and comfortably and with a minimum of fatigue.</p>
<p><b>Principle seven: Size and Space for Approach and Use</b></p> <p>Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.</p>

An equitable and flexible social policy would, by analogy, be designed to meet the needs of as many people as possible, congruent with the overall objectives of the policy or law, be it income support, education, employment, transportation or housing. The analogy between social programs and products and environments is in fact quite close with regard to these two principles. The idea is that social programs ought to be designed so that their objectives are met by as many people as possible, and so takes into account, in design and



implementation, the full range of human variability in capacity and need. What policy flexibility means in practice will depend on the program's objectives and how variations in human capacities are factored into implementation plans to achieve those objectives for different individuals. For example, transportation policy can meet its universal objective of moving as many people as possible by taking into account the needs of people who are blind, but perhaps does not need to take into account people with depression. For obvious reasons, equitable and flexible policy will not segregate or stigmatize individuals or groups.

The next two principles of UD deal with the level of complexity of, and preparation required for the use of a product or environment. Principle Three states that designed use should be simple and intuitive, consistent with user expectation, and accommodate a wide range of literacy and intellectual ability. Principle Four adds the requirement of informational accessibility, the requirement that instructions and other pre-requisites for use be informative and, depending on the user's sensory abilities, 'legible'.

The analogy here is also straightforward. Social policy must be designed so that its objectives and benefits are transparent to all. In part this means for social policy exactly what it means for products and environments, namely clear and accommodating information about the program so that each person can benefit from it in ways appropriate to his or her needs. As well, the injunction against complexity and obstacles to information flow entail, in the arena of social policy, the twin demands of transparency and democratic participation in social and political life. Social policy is, after all, a product of the political system - an output which like any product or environment is intended to meet needs. Therefore, universal social policy would demand the free flow of information between those who design and those who use and benefit from social policy.

Finally, the Principle Five highlights the importance, when designing products or environments, of tolerance for error. This means that when products and environments are designed for maximal flexibility, to accommodate a variety of users, the possibility of mistaken use, creating hazards, is also increased. To

deal with this side effect of flexibility, designers must first be aware of its possibility and design in ways that minimizes hazards. More generally, this principle can be understood as counselling vigilance for the misuse or inappropriate use of universally designed environments.

This is a potentially powerful principle for social policy development. For social policy and programs from legislation, the analogues of product misuse and dangerous environments are the unfortunately common anomalous outcomes that undermine, when they do not contradict, the desired objectives. Policies and laws that seek to employ people but which, because of bad design, discourage people from working have failed to heed this principle. Similarly, programs that seek to ensure economic self-sufficiency for people, but which can be manipulated by those not in financial need, also fail. How these policy defects can be designed out is, of course, an enormously difficult challenge. Still, UD advises sensitivity to the effects of programs and legislation on people's lives, and a vigilance to ensure that flexibility does not undermine effectiveness.

### **Universal social and legal policy -- tentative examples**

Can we imagine what universal social and legal policy would be like? In some cases, no imagination is needed. As already mentioned above, there are several examples of UD-inspired legislation already in effect. To be sure, these are often restricted in scope, and qualified in ways that limit their universality. Nonetheless, they can be used as examples of the implementation of principles of equity and flexibility in law. For present purposes, instead of looking at the details of existing models in legislation and policy, it will be profitable to be more speculative and consider generally how universal design principles might play themselves out in key areas of law and policy. We consider two examples; health care policy and welfare or social support policy. Universal design in health care: universal health care

### Universal design in health care: universal health care

It should not come as a surprise that the best example of a ‘universally designed’ health care policy is a single-payer, publically administrated and funded, universal health care system. Of the existing examples in high resource countries, Canada’s remains the most comprehensive and politically secure. In Canada, coverage is universal in the sense that every citizen qualifies for the same, comprehensive, level of health care regardless of medical history, personal income or standard of living; coverage is not restricted to any one part of the country but is portable, and all insured persons have reasonable access to all health care facilities (and all health care providers have reasonable compensation for their services) (Canada, 2005). Although many health care systems in the world have universal coverage, as for example Spain, Canada is unique in not have a complementary private system operating simultaneously (Blendon et al., 1991).

It should be said it is not accurate to say that health care in Canada is totally accessible, in the sense that the buildings, offices and other facilities themselves meet the requirements of universal design; like all other countries, Canada has this challenge still to meet. But at the policy level, the Canadian health care system arguably satisfies the UD principles. Any move away from this sort of health care arrangement, and certainly any unregulated and privatized approach, will violate the UD principles of equity and flexibility: almost by definition, a non-universal health care system includes provisions that prejudicially distinguishes people with ‘pre-existing health conditions’ from those without.

At the same time, despite its virtues, there is no reason to believe that the Canadian health care system accommodates, or even acknowledges, the other three UD principles of simplicity, informational accessibility and tolerance for error. These criteria are primarily administrative and procedural: features of how services are delivered, rather than what services are delivered. Unfortunately, centralized and government-run systems, especially those of the expense and complexity of health care systems, are not always efficiently administrated and managed. To be sure, the administrative costs of the

Canadian system of health delivery is far lower than that in the US, especially considering that the Canadian system achieves nearly 100% coverage, whereas the private component of the US covers between 75-80% of the population (Guyatt et al., 2007). But the administration the Canadian system would need to be substantially altered in order to live up to the procedural UD principles.

### **Universalistic welfare programming**

Universalism in social welfare or social protection design is not a new idea. Richard Titmuss, an English theorist responsible for much of our understanding of the philosophy of welfare in the English speaking world, argued that, from its inception in the late nineteenth century in Bismarck's Germany, it was thought to be essential to welfare policy that services be made available and accessible to the whole population in order to avoid loss of status, dignity or self-respect on the part of service users: "There should be no sense of inferiority, pauperism, shame or stigma in the use of a publicly provided service; no attribution that one was being or becoming a 'public burden'" (Abel-Smith, 1987: 146).

Universalism could only be achieved, Titmuss argued, if welfare was made available, not as a special service grounded in charity or compassion - or as we might also say, in response to 'special needs' - but a universal public service grounded in "the social rights of all citizens to use or not to use as responsible people the services made available by the community in respect of certain needs which the private market and the family were unable or unwilling to provide universally" (Abel-Smith, 1987: 146). Universal provision was essential not merely to avoid stigmatization, however. If these services were not provided "for everybody by everybody" the chances were that they would not be provided at all. Moreover, the realization that prevention of the 'social ills' associated with poverty, disease, neglect, illiteracy and destitution was far more efficient than responding after these ills had manifested themselves, the early architects of welfare soon learned the lesson that to be effective in action in a highly differentiated and economically unequal society, these services had to be delivered universally.

In the last two decades, universalism has had to face the claim that it is economically inefficient and that selective or targeted policies, based on needs assessment or means-testing are better at targeting assistance to the economically weakest part of the population, namely those unable to purchase insurance and services on the market for themselves (Berkowitz, 1989). Economists also argue that the stigma associated with targeted assistance helps to keep costs down by reducing the demand for the services. Such a system, it is hoped, supports only those who are 'truly needy'. Universalism is thus opposed to the political principles that support only the truly needy and promote the privatization of social services for others.

This purely economic consideration has been very popular. The opposing position, which sees welfare as a right of citizenship, is a manifestation of a universal sense of equality, which underwrites UD principles. Here the argument is that a social commitment to meaningful equality demands equal sharing of the benefits and burdens of citizenship (Marshall, 1965; Culpitt, 1992). Moreover, the current preference for targeted welfare programming is often supported by the claim that universalistic welfare policy is more expensive, although there are in fact no studies that actually show that to be the case.

There are no existing examples of purely universalistic welfare systems - although Sweden's social support system probably comes the closest. Nonetheless attempts have been made to sketch out what such a system would look like. Welfare economist Bo Rothstein, for example, has argued that a universal system would consist of three interlocking components: 1) publicly produced and universally available services such as health care, basic education, care of children and of the elderly, as well as publicly regulated and subsidized housing; 2) a system of universal flat-rate benefits tied either to citizenship or residency, such as basic pensions and child allowances; and 3) a mandatory social insurance system, in which benefits reflect earnings on the labor market and are designed to provide income security, by means of supplementary (earning related) pensions scheme, sickness pay, and parental insurance (Rothstein, 1998). Together, such a system would, he claims, lower

the costs associated with providing ‘special’ services to populations defined by complex eligibility requirements.

Ironically, a universal system of this sort might not have an identifiable ‘disability policy’ at all. But that is as should be expected since ‘disability policy’ is implicitly targeted or selective by its very nature. A universal social support system would likely set standards of participation in major life areas - education, employment, housing, transportation, family and personal care, medical care and so on - and then seek to secure equalization of opportunities and human rights for each area of participation in resource terms and in accordance with these standards. Individuals with different levels of need would access different resources that are appropriate to the standard level of participation for that area suitable for the individual. Public provision would be universalized by satisfying the principles of equity and flexibility in the provision of basic needs, across the full spectrum of normal human variability. Such a system, subject to similar procedural and administrative concerns already mentioned in the case of health care, would very likely satisfy the UD principles.

### **Universal policy and law: the need for basic research**

This paper is an attempt, first to create analogues of principles of UD that are applicable to law and social policy, and secondly to look at potential examples of the application of these principles to law and policy in order to clarify, and recommend the use of, the underlying principle in Irving Zola’s seminal paper on universalized disability policy. UD principles, we have argued, are directly applicable to social policy and law, and we have suggested that in two major social policy areas, health and welfare, that applications of these principles is feasible and, in some restricted examples has actually been implemented in these policy areas. Our primary objective of showing the feasibility of universal policy and law has been satisfied.

Research is needed, however, to be more precise about how these policies live up to the promise of universal design and accord with UD principles. The value

of this research, moreover, would be two-fold: not only could we assess existing programs against the principles of UD, we could also use these programs as further guides to devise more specific and operational guidelines to test existing or proposed social programs. This methodology is appropriate where, in the absence of a 'gold standard', our goal is to further refine our understanding of the objectives of social policy.

Basic research is also needed to construct the operational principles and guidelines that will move universal disability and law from theory to practice. To be workable, guidelines presume outcome measures and other techniques for assessing success and failure. These measures will necessarily involve both health and non-health determinants of basic human functioning and capacity. The Convention on the Rights of Persons with Disabilities delineates these basic areas of human life, areas in which everyone, around the world, has a moral claim to participate, and can therefore serve as a template for this research.

The aim of a universal policy is to enhance the capacities and opportunities of all citizens, which in turn makes possible the achievement of participation in those areas of life that can plausibly be argued to be basic for human life. What areas of life these are, how they interact and their ranked importance, are matters that stand in need of basic research, empirical and theoretical. Universal disability policy and law can only move from speculative ideal to concrete reality when this research is accomplished.

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## INCLUSIVE COLLEGE TEACHING: UNIVERSAL DESIGN FOR INSTRUCTION AND DIVERSE LEARNERS

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*Abstract:* Shifts in enrollment patterns are affecting college classrooms and elements of teaching ranging from options for delivering course materials online to multiple methods of assessing learning. With the enrollment of more diverse college learners comes a call to intentionally design instruction that is more inclusive and responsive to multiple learning styles. The notion of Universal Design for Instruction (UDI) is examined from its roots in the architectural field to its application as a model for teaching that anticipates diversity including students with disabilities. Principles of UDI are defined, and pedagogical examples are provided. Several implementation projects based on the UDI concept are described as are preliminary results regarding outcomes. Substantive issues are identified that have bearing on the direction this innovative idea will take over the next several years.

*Keywords:* universal design for instruction (UDI), inclusive college teaching, diverse college students, inclusive instruction, universal design.

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### **Inclusive College Teaching: Universal Design for Instruction and Diverse Learners**

Postsecondary colleges and universities in the United States are becoming more diverse with respect to ethnicity, enrollment status (i.e., fulltime, part-time), students with disabilities, and number of reentry and transfer students. The implications of these changes are notable for faculty and instructors who are committed to creating inclusive learning environments. By anticipating diversity and intentionally designing instruction that is responsive to a range of learners, the concept of access is extended from buildings and spaces to classrooms

(traditional or virtual), laboratories, and course materials. A change in viewing instructional access for students with disabilities from a legal to a pedagogical perspective is timely in light of demographic data about their enrollment status. Postsecondary students with disabilities now comprise at least 11% of undergraduates in the U.S. (U.S. Government Accounting Office, 2009), and efforts to assure flexible instructional practices are gaining momentum often under the rubric of teaching to accommodate different learning styles (Davis, 2009; Nilson, 1998). The focus of this article is an examination of a model for college teaching, Universal Design for Instruction (UDI), beginning with an overview of its foundations in the barrier-free architectural movement to implementation in multiple settings and dissemination efforts to an emergent record of results regarding implementation outcomes.

### **Universal Design for Instruction: Its Genesis**

In the 1970s, the social and political barrier-free and civil rights movements in the U.S. coalesced and culminated in laws that have profoundly altered the landscape of education (McGuire, 2007). Inherent in these movements were constructs of access and equity that are reflected as core values in legislation such as the Architectural Barriers Act of 1968 (PL 90-480), the Rehabilitation Act of 1973 (PL 93-112), the Education for All Handicapped Children Act of 1975 (PL 94-142)(now known as Individuals with Disabilities Act) and its amendments, the Technology Act of 1988 (PL 100-407), and the Americans with Disabilities Act of 1990 and its 2008 amendments (PL 110-325). The impact of this legislation has resulted in more students with disabilities pursuing higher education and availing themselves of legal protections that assure non-discriminatory treatment. Access to instruction is often facilitated by statutory provisions for academic accommodations (e.g., extended time on tests, note takers) that are intended to ameliorate the functional impact of a disability and to “level the playing field” without altering the essential elements of a course or program of study. Salmen (2011) has pointed out that this accessibility approach “is about compliance with regulations that protect a small percentage of the population” (p. 14).

An alternative to this legalistic model emanates from the concept of universal design. As campuses reflect greater diversity, it is imperative that the college community respond in inclusive ways. The idea of anticipating diversity and proactively planning for it is embodied in the work of Ronald Mace and his colleagues at North Carolina State University in the field of architecture and product design. Recognizing the continuum of human diversity, Mace and others articulated an approach to design that was proactive: rather than retrofitting elements (e.g., ramps, electronic door openers) for access to a building, why not intentionally design features that assure access from the beginning? The term, universal design (UD), was coined by Mace in the early 1970s and has served as the foundation for widespread design innovation, training, technical assistance, and research in the physical environment (Center for Universal Design, 2008). UD can be thought of as “the process of embedding choice for all people into the things we create” (Salmen, p. 14).

An opportunity to extend this concept from the physical to the instructional environment in colleges and universities presented itself in the late 1990s. In light of the trend toward more students with disabilities enrolling in postsecondary education and the important role faculty play in the instructional process, the U.S. Department of Education, Office of Postsecondary Education (OPE), authorized its first competition in 1999 to support “innovative grants to IHEs to improve their ability to provide a quality postsecondary education for students with disabilities” (U. S. Department of Education, n.d.). With federal support through grant funding, the Center on Postsecondary Education and Disability (2009) at the University of Connecticut began its work to develop and promote inclusive instructional methods and strategies for faculty to use in the design and delivery of course content and the assessment of learning outcomes.

### **Universal Design for Instruction: The Concept and its Principles**

Extension of universal design from the built environment to the instructional environment, particularly at the postsecondary level, is, in many ways, a revolutionary idea. Historically, teaching in colleges and universities has followed the teaching paradigm, described by Barr and Tagg (1995) to focus on knowledge transfer from faculty providing instruction to students as passive

recipients. In the 1990s, a dramatic shift began a focus on producing learning characterized by a constructivist, inquiry-based, problem-solving, cooperative learning paradigm. King summarized this transformation in her “sage on the stage” to “guide on the side” analogy (1993, p. 30). Scott, McGuire, and Foley (2003) framed this change in emphasis within the concept of universal design posing a penetrating question: by anticipating diverse learners in the classroom and intentionally designing inclusive instruction, is it possible to create learning environments that are “usable by a broader range of students while maintaining the ‘aesthetics’ of the product, that is, “the academic integrity of the course” (p. 41)? An assumption of the authors is that faculty are content experts who can refine their pedagogical skills to enhance the instructional process (McGuire & Scott, 2006).

Anchored in the literature on universal design, effective instruction in higher education, and effective instruction for students with learning disabilities, Scott et al. (2003) identified seminal resources for practice in the areas of postsecondary instruction, learning disabilities, and universal design. These sources were examined in juxtaposition with the seven principles of UD from North Carolina State University (Center for Universal Design, 1997) as well as Chickering and Gamson’s Seven Principles for Good Practice in Undergraduate Education (1987) resulting in the concept, Universal Design for Instruction (UDI), and nine principles of practice. The definition and principles were then reviewed by experts in UD, postsecondary disability services, and effective college teaching to determine their relevance and utility for guiding faculty in the design and delivery of course content. College students with learning disabilities (LD) also provided input. With favorable feedback on the construct and principles from all constituents, the concept of UDI is defined as “an approach to teaching that consists of the proactive design and use of inclusive instructional strategies that benefit a broad range of learners including students with disabilities” (Scott, McGuire, & Embry, 2002). Building on the work of Mace and the Center for Universal Design, Scott, McGuire, and Shaw (2001) developed the nine Principles of Universal Design for Instruction<sup>®</sup>, a framework for faculty

to use as they plan and deliver instruction. Table 1 includes the principles, definitions, and instructional examples.

*Table 1. Principles of Universal Design for Instruction. Source: Scott, McGuire, & Shaw, 2001.*

Principle	Definition	Example(s)
<u>Principle 1:</u> Equitable use	Instruction is designed to be useful to and accessible by people with diverse abilities. Provide the same means of use for all students; identical whenever possible, equivalent when not.	Provision of class notes online. Comprehensive notes can be accessed in the same manner by all students, regardless of hearing ability, English proficiency, learning or attention disorders, or note taking skill level. In an electronic format, students can utilize whatever individual assistive technology is needed to read, hear, or study the class notes.
<u>Principle 2:</u> Flexibility in use	Instruction is designed to accommodate a wide range of individual abilities. Provide choice in methods of use.	Use of varied instructional methods (lecture with a visual outline, group activities, use of stories, or web board based discussions) to provide different ways of learning and experiencing knowledge.
<u>Principle 3:</u> Simple and intuitive	Instruction is designed in a straightforward and predictable manner, regardless of the student's experience, knowledge, language skills, or current concentration level. Eliminate unnecessary complexity.	Provision of a grading rubric that clearly lays out expectations for exam performance, papers, or projects; a syllabus with comprehensive and accurate information; a handbook guiding students through difficult homework assignments.
<u>Principle 4:</u> Perceptible information	Instruction is designed so that necessary information is communicated effectively to the student, regardless of ambient conditions or the student's sensory abilities.	Selection of text books, reading material, and other instructional supports in digital format or online so students with diverse needs (e.g., vision, learning, attention, English Language Learners) can access materials through traditional hard copy or with the use of various technological supports (e.g., screen reader, text enlarger, online dictionary).

<p><u>Principle 5:</u> Tolerance for error</p>	<p>Instruction anticipates variation in individual student learning pace and prerequisite skills.</p>	<p>Structuring a long-term course project so that students have the option of turning in individual project components separately for constructive feedback and for integration into the final product; provision of online “practice” exercises that supplement classroom instruction.</p>
<p><u>Principle 6:</u> Low physical effort</p>	<p>Instruction is designed to minimize nonessential physical effort in order to allow maximum attention to learning.  Note: This principle does not apply when physical effort is integral to essential requirements of a course.</p>	<p>Allowing students to use a word processor for writing and editing papers or essay exams. This facilitates editing of the document without the additional physical exertion of rewriting portions of text (helpful for students with fine motor or handwriting difficulties or extreme organization weaknesses while providing options for those who are more adept and comfortable composing on the computer).</p>
<p><u>Principle 7:</u> Size and space for approach and use</p>	<p>Instruction is designed with consideration for appropriate size and space for approach, reach, manipulations, and use regardless of a student's body size, posture, mobility, and communication needs.</p>	<p>In small class settings, use of a circular seating arrangement to allow students to see and face speakers during discussion—important for students with attention deficit disorder or who are deaf or hard of hearing.</p>
<p><u>Principle 8:</u> A community of learners</p>	<p>The instructional environment promotes interaction and communication among students and between students and faculty.</p>	<p>Fostering communication among students in and out of class by structuring study groups, discussion groups, e-mail lists, or chat rooms; making a personal connection with students and incorporating motivational strategies to encourage student performance through learning students’ names or individually acknowledging excellent performance.</p>
<p><u>Principle 9:</u> Instructional climate</p>	<p>Instruction is designed to be welcoming and inclusive. High expectations are</p>	<p>A statement in the class syllabus affirming the need for class members to respect diversity in order to establish the expectation of tolerance as well as to</p>

	<p>espoused for all students.</p>	<p>encourage students to discuss any special learning needs with the instructor; highlight diverse thinkers who have made significant contributions to the field or share innovative approaches developed by students in the class.</p>
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Validation of UDI and its principles included studies with faculty recognized for their teaching excellence, students with LD and attention deficit hyperactivity disorder (ADHD), and graduate teaching assistants. Eighteen faculty from 10 disciplines (engineering, biology, family studies, mathematics, physics, accounting, art history, plant science, education, and psychology) designated as University Teaching Fellows were interviewed to gather their perspectives about effective teaching strategies (Madaus, Scott, & McGuire, 2003a). This academic recognition is one of the highest honors at the research intensive institution where the study was conducted. While these distinguished professors did not use the terminology of UDI, several themes about recommended instructional strategies resonated with the UDI principles: (a) providing explicit structure and clarity about a course, assignments, and performance expectations (Principle 3, Simple and Intuitive); (b) actively engaging students in the learning process (Principle 8, A Community of Learners); (c) teaching learning strategies useful in specific disciplines (Principle 5, Tolerance for Error) ; and (d) creating a positive learning environment with high expectations for all students (Principles 1 and 9, Equitable Use and Instructional Climate). To explore student perceptions about effective and inclusive instruction, the insights of 23 students with LD and ADHD were synthesized across four focus groups. As was the case with the outstanding teaching faculty, themes reflected the UDI principles to provide strong evidence of concurrent validity between elements of inclusive instruction and the literature derived UDI principles. Establishing clear and explicit course expectations (Principle 3, Simple and Intuitive), presenting information in multiple formats (Principle 2, Flexibility in Use), providing frequent formative feedback (Principle 5, Tolerance for Error), reinforcing challenging standards for learning (Principle 1, Equitable Use), and creating a welcoming classroom climate (Principle 9) were noted as



distinguishing features of excellent instructors (Madaus, Scott, & McGuire, 2003b). Finally, a qualitative study of five graduate teaching assistants (GTAs) explored their beliefs about inclusive teaching and how they enacted those beliefs in their teaching practice (Embry & McGuire, in press). Disciplines included mathematics, accounting, experimental psychology, and business management. Many of these GTAs' teaching practices were consistent with UDI and its principles although none of the GTAs were familiar with the concept. For example, one GTA noted that, "I try to use a variety of assessment methods to give equal opportunity to different kinds of people...some people are more comfortable with oral examination; some are more comfortable with written" (p. 13)(Principle 2, Flexibility in Use). Another shared that, "I work really hard in not putting them off with complexity...saying 'Look, it's hard. But you can do it. Everybody can do it'" (p. 12) (Principles 3 and 9, Simple and Intuitive and Instructional Climate). The authors recommend the use of UDI and its principles as a platform for GTA training. Familiarity with an explicit theoretical framework would prepare GTAs for crafting their teaching in an explicit manner that anticipates a broad range of learners and intentionally builds in methods and strategies that are responsive to diverse learning styles.

### **Universal Design for Instruction: Implementation and Dissemination Activities**

Three 3-year grant funding cycles sponsored by the U.S. Office of Postsecondary Education have provided opportunities to apply UDI in multiple settings (for a detailed history, see <http://www.udi.uconn.edu/index.php?q=content/project-history>). During the first funding cycle (1999-2002), foundational work extended the concept of UD to college teaching resulting in the definition of UDI and articulation of UDI principles. A range of activities included the development of fact sheets regarding UDI, UDI training modules, and resources for faculty that relate to inclusive postsecondary instruction for diverse learners including those with disabilities. A web site, Facultyware ([www.facultyware.uconn.edu](http://www.facultyware.uconn.edu)), served as the host for a compendium of faculty "products," defined as any identifiable component of instruction used to accomplish a set of specifiable student performance outcomes. Faculty from diverse institutions (2-year, 4-year, public



and private) across the U.S. submitted examples of instructional methods that underwent a peer review process and were determined to reflect one or more UDI principles. Thirty two products developed by faculty authors who used UDI principles in their course planning, delivery, and/or assessment are posted in the Instructional Freeware section of Facultyware (see [http://www.facultyware.uconn.edu/cfm\\_pages/published\\_products.cfm?PageNum\\_qProducts=1](http://www.facultyware.uconn.edu/cfm_pages/published_products.cfm?PageNum_qProducts=1)).

During the second funding cycle (2002-2005), the focus was on the application of UDI through learning communities of faculty who were trained on UDI and its principles, applied the concept to one or several courses, and provided feedback about professional development materials for dissemination through the Facultyware web site. Several of the products in the Instructional Freeware section are from faculty in participating learning communities. The current funding cycle (2008-2011) extends the UDI concept and principles to online and technology blended learning environments. With a focus on “faculty as designer,” the project targets electronic teaching tools (called e-Tools) that faculty can implement in their courses without requiring the support of an instructional or web design team. E-tools are defined as digitally presented materials, instructional techniques, and/or strategies that can be used or manipulated by a course instructor to proactively create a learning environment that benefits a broad range of learners. Faculty from several types of institutions are field-testing e-Tools in their online and blended courses. Feedback from faculty and students who are using the e-tool about ease of use and benefits will be posted on the project web site ([www.udi.uconn.edu](http://www.udi.uconn.edu)). To date, more than 50 e-tools and strategies are posted along with instructional guides on how to use each e-tool.

Systemic implementation activities extend beyond the scope of these initiatives at the University of Connecticut. At Longwood University in Virginia, Project LINC (Learning in Inclusive Classrooms), based on UDI and its principles, is in its final year of addressing concerns about the challenges of introductory level foreign language (FL) instruction (Scott & Edwards, 2011). This is a topic of particular relevance to students with language-based learning disabilities who

often struggle to meet FL requirements of a liberal arts curriculum. The goal of the project is to develop a portable and sustainable training curriculum to support new, part-time, and temporary foreign language instructors in inclusive classroom techniques. A foundation workshop which included information on UDI and its application was followed by monthly topical workshops to address critical concerns relating to FL instruction. Preliminary project results are presented in the next section. Another implementation project is underway at Florida Gateway College, a two year institution that is committed to working with students who do not meet minimal college-level requirements and must take developmental coursework before enrolling in the standard degree-focused curriculum. Twenty developmental education instructors have participated in a two day training workshop based on UDI (see <http://www.projectexcelprogram.com/UDI> for training materials). These instructors are meeting periodically to brainstorm about instructional strategies that reflect UDI principles, and are deliberately planning ways to integrate these strategies into their coursework. Data collection on course outcomes (grades, completion rates) is ongoing (C. Rodesiler, personal communication, September 29, 2010).

Dissemination activities regarding UDI as a framework for inclusive college instruction have been widespread. Data from the evaluation of the second OPE grant funded initiative indicated extensive outreach. “Hits” on the Facultyware site averaged more than 300,000 per year; more than 2,000 professionals had been trained in the concept of UDI at 34 national and international presentations; Google citations exceeded 300. Although a systematic monitoring protocol for dissemination activities is not operative due, in part, to funding constraints, it is reasonable to project even broader dissemination via the Internet and publication of 21 manuscripts in peer-reviewed journals. According to professional contacts and correspondence, numerous colleges have created links to the UDI web sites in their institution’s web sites, often within teaching and learning centers and disability services offices.

## Emerging Evidence of Implementation Outcomes

As noted by several authors (Burgstahler, 2008; McGuire, Scott, & Shaw, 2006; Roberts, Park, Brown, & Cook, 2011), it is critical to examine the outcomes of implementing the construct of universal design to promote inclusive college teaching. The idea of universal design applied to instruction is intuitively appealing: who could disagree with the value of creating instructional environments that are responsive and sensitive to diverse learners? Yet until a more extensive research base of efficacy exists, it is premature to promote UDI or other applications of universal design as “best practices” for faculty adoption. However, preliminary results of several projects that have implemented universally designed teaching initiatives are encouraging. Using two broad measures of student outcomes, final grades and retention, Project LINC results indicate that the grades of students with and without disabilities across instructors and across languages are now similar whereas previously, fewer students with disabilities received final grades of A-C, and more received Fs. Similarly, the withdrawal rate for both groups of students is now more consistent whereas previously the withdrawal rate of students with disabilities was more than three times that of students without disabilities. The authors judiciously note that no single causative factor can be identified (Scott & Edwards), but these data suggest that faculty and instructors can modify their teaching methods to promote inclusive instruction. In a 2002-2003 project running concurrently with the first UDI initiative at the University of Connecticut, the University of Guelph conducted faculty training based upon an adaptation of the seven principles of UD from North Carolina State University (Yuval, Procter, Korabic, & Parker, 2004). Student perceptions about the effectiveness of universal instructional design affirmed positive benefits in relation to the instructional environment and student academic self-efficacy. This author is aware of several UDI based implementation projects currently in progress. Results from these projects as well as efficacy data from other postsecondary institutions examining UD based interventions may lend support for an inclusive model of college teaching: intentionally designing an instructional environment that anticipates diversity among learners and offers

choices that extend beyond accessibility, a legal concept, and promote the notion of equity. It will be important to monitor outcomes research on a regular basis recognizing the lag time between field-based research and publication of manuscripts reporting on results in refereed journals.

## Discussion

Considering that the history of access to postsecondary education for students with disabilities has historically rested on the legally mandated provision of accommodations and auxiliary aids, the movement to create inclusive instructional environments that are responsive to diverse learners including those with disabilities by applying the concept of universal design is provocative and challenging. Disciplinary expertise in a content area is a hallmark of the academy, yet priorities are shifting to emphasize effective instructional pedagogy that will generate positive student learning outcomes (Fink, 2003). Extending a concept such as UD from one context, architecture and product design, to another, instructional environments, comprises an innovation defined by Rogers (2003) as “an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (p. 12). Features of universal design are now commonplace in built environments, in no small part due to statutory requirements for physical access. While some may not agree that UD in education is similar to UD in the built environment (Edyburn, 2010), many share a belief that applying universal design principles in higher education classrooms is a noteworthy goal. Over the past decade, efforts to apply UD to college teaching have escalated as reflected in a sparse but growing literature about this innovative idea (e.g., Association on Higher Education and Disability, 2004-2010; Darr & Jones, 2008; Finn, Getzel, Asselin, & Reilly, 2008; Higbee, 2008; Rose, Harbour, Johnston, Daley, & Abarbanell, 2008; Schelly, Davies, & Spooner, 2011; Scott & McGuire, 2008). Rogers noted that, “Getting a new idea adopted, even when it has obvious advantages, is difficult” (p. 1). It is too soon to speculate about the trajectory of efforts to infuse universally designed instructional strategies into college teaching, but it is timely to reflect on some

of the challenges inherent in systemic change. The literature on diffusion of innovation offers food for thought. For example,

- Is there consensus at the postsecondary level that the concept of UD applied to instruction and learning is a viable construct, a mechanism for reframing disability within a classroom as a point on a continuum of human diversity?
- What mechanisms offer efficient approaches by which field-based implementation efforts grounded in UD and their outcomes can be systematically identified and reliably monitored with a goal of synthesizing results across settings?
- What are the appropriate indicators of the efficacy of UDI? Student perceptions about their learning and methods that facilitate it provide a window via self-reflection, but this presumes proficiency and insight into linking instructional interventions with personal learning attributes and outcomes. Is student performance in a course intentionally designed using the UDI framework an indicator of the efficacy of this instructional model? How will variations in students' prior knowledge and experiences be accounted for in research designs?
- When considering change from a teaching to a learning paradigm, and the critical role faculty play in this shift, are there differences in inclusive pedagogical methods according to discipline?
- Assuming a body of efficacy research on UDI, what are the process elements that are critical for promoting such an innovative approach among faculty and future faculty?

In many circles, evidence-based research is the coin of the realm. Yet, it is noted that research often appears to have limited or no impact on practice (Nutley & Davies, 2000). It behooves those of us who are practitioners, teachers, and promoters of this inclusive paradigm to proceed objectively, collaboratively, and analytically. As opined by Edyburn (2010), the stakes are such that failure to address substantive issues about an innovative idea such as UD for instruction may well lead to the passing of another education fad.

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## UNDERSTANDING DISABILITY AND THE IMPORTANCE OF DESIGN FOR ALL

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**Abstract:** This paper will address recent debates surrounding the nature and cause of the complex process of disablement and their relevance to understanding calls for a universally accessible physical and cultural environment. It is divided into three main sections. The first part will explore changing perceptions of disability. Attention will centre on the traditional individualistic medical approach, the socio-political understanding or 'social model of disability' and the recent 'biopsychosocial' model of disability exemplified by the World Health Organisation's International Classification of Functioning, Disability and Health. This will be followed by a discussion of the usefulness of the concept of 'universal design'. The final section will discuss the significance of these developments in light of globalisation, associate economic, political and social crises, and the struggle for a fairer and just global society.

**Key words:** Access, disablement, equality, policy, universal design

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### Introduction

Since the middle of the last century our understanding of the complex process of disablement has been gradually but significantly transformed from an individual medical problem to a major socio/political issue with implications for society as a whole. Led by disabled activists in the 1960s this transformation has resulted in a general recognition both at the local, national and international levels, that people with impairments whether physical, sensory or cognitive and labelled 'disabled' experience a range of environmental and

social barriers that inhibit their active participation in the economic, political and cultural development of their communities. It is also widely acknowledged that this exclusion is manifest in the design and construction of physical and cultural infrastructures. These developments find expression in national anti-discrimination legislation to address discrimination against disabled people (Lawson and Gooding, 2005; Doyle, 2008), United Nations (UN) initiatives such as the UN Convention on the Rights of Persons with Disabilities (UN, 2009), and calls for the inclusion of the principles of 'universal design' into the production of the physical and cultural environment (Imrie, 2000).

This paper will provide a broad overview of these developments and will argue that the quest for 'access for all' is an essential element in the struggle for a fairer and just society. It is divided into three main parts. The main part of this article will explore changing perceptions of disability. Attention will centre on the traditional individualistic medical approach, the socio-political understanding or 'social model of disability' and the recent 'biopsychosocial' model of disability. This will be followed by a discussion of the debates surrounding 'universal design'. The final section will discuss the significance of these developments in light of globalisation, associated economic, political and social crises, and campaigns for a fairer and more equitable global society.

### **Changing views of disability**

To understand changing perceptions of disability it is important to remember that there is substantial anthropological and sociological evidence that societal responses to people with impairments or 'long term health' conditions varies across time, culture and location (Hanks and Hanks, 1948; Ingstad, 2001; Ingstad and Whyte, 1995; Lemert, 1951; Miles, 1995; 2001). Yet within western cultures there has been a consistent cultural bias against people with impairments since at least the ancient world of Greece and Rome (Barnes, 1997; Garland, 2010; Stiker, 1999; Ryan and Thomas, 1987).

There is also general agreement that the economic and social upheavals accompanying the ascendance of industrial capitalism and associated ideologies: liberal utilitarianism and the medicalisation of social deviance in the late 18th

and 19th centuries, led to the institutionalisation of discriminatory policies and practices. These included the systematic removal of disabled people from the community into segregated institutions of one form or another and the creation of an economic, political and cultural infrastructure geared almost exclusively to the needs of a population assumed to be devoid of impairment.

Since the atrocities of the 'Second World War' however, there has been a general 'softening' of attitudes in policy circles in wealthy states such as Britain, Europe and the United States of America (USA). This was the result of a moral obligation felt by politicians and the general public toward the large numbers of civilians and military personnel injured during the war, and a substantial growth in the numbers of disabled and elderly people due to increasing affluence and medical advances in the post war years. There followed an expansion of community-based services provided by state and voluntary agencies, the politicization of disability by disabled people and their organizations, and calls for clarity in definitions of disability by policy makers, analysts and researchers within and across nations states (Barnes, 1991; Borsay, 2005; Finkelstein, 1980; Oliver, 1990, 1996, 2009).

### **The individual medical model of disability**

The first attempt to provide a universally accredited definition of disablement was produced by the World Health Organization (WHO). In order to provide consistency and minimize confusion internationally the WHO commissioned a team of researchers at Manchester University, England, to expand on the WHO's International Classification of Disease (WHO, 1976) to cover long term or 'chronic illnesses'. The result: The International Classification of Impairments, Disability and Handicap (ICIDH), was published in 1980. Drawing heavily on previous definitions of disability from around the world, notably the USA and UK, it uses a threefold typology of 'impairment', 'disability' and 'handicap'. Thus:

- Impairment: any loss or abnormality of psychological, physiological or anatomical structure or function.

- Disability: any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being.
- Handicap: a disadvantage for a given individual, resulting from an impairment or a disability that limits or prevents the fulfilment of a role that is normal (depending on age, sex, social and cultural factors) for that individual (WHO, 1980; 27-9).

Advocates maintain that the ICIDH represents a major departure from previous classifications as the concept 'handicap' has been extended to account for socio-economic disadvantage or 'economic self sufficiency' and therefore represents a 'socio medical model of disability' (Bury, 1996).

Internationally however the ICIDH has not been very successful at identifying who is and who is not disabled. It is based on a particularly narrow set of western values and assumptions of 'normality'. Davis (1995) maintains that the word 'normal' only entered the English language around 1840. This was when the pressures of industrialisation were forcing governments to define, classify and control populations (Oliver and Barnes, 1998). But perceptions of 'normality' change over time and place even within and across western cultures. Indeed, to define someone as 'not normal' implies a value judgement on that person's social worth. This is most obvious with the application of labels such as 'mental illness' and 'mental handicap'.

Most importantly orthodox medical definitions such as the ICIDH affirm that impairment is the principal cause of disability and/or handicap. This assertion reinforces the view that the humans are flexible and adaptable while physical and social environments are not. This flies in the face of reality since historically humans have always shaped the environment to suit their needs rather than the other way round. It also downplays the role of legislation and policy reforms to address the various economic and social disadvantages experienced by people with impairments and labelled 'disabled'.

The disabled person is expected to make the best of their diminished circumstances and focus on individual adjustment and coping strategies with

appropriate professional direction (Finkelstein, 1991). Hence they become objects to be treated, changed, improved and made 'normal' (Oliver and Barnes 1998). Whilst medical and rehabilitative interventions may be appropriate to treat disease and illness, it is increasingly apparent that they are less so for disability (French and Swain, 2008).

Further, the ICIDH implies that impairment, disability and handicap are essentially static states. Apart from the fact that this is clearly inaccurate, it creates artificial divisions between people with and without impairments where there should not and need not be any. Such a situation is especially ludicrous considering the range of conditions included in the WHO scheme. In terms of impairment, besides a whole host of illnesses and diseases, conditions such as 'baldness', 'pregnancy' and 'homosexuality' are listed. With reference to 'disability' items such as 'failure to get to work on time' or lack of interest in local or national events' are included. These so-called conditions might easily be questions of choice or environment rather than of organic or intellectual pathology. Yet the ICIDH 'has a classification for every feature of human physicality' (Shakespeare 1994: 104). It is hardly surprising then that internationally interpretations of both impairment and disability vary considerably. Such considerations weaken, if not undermine altogether, the reliability of historical and international comparisons (Edie and Loeb, 2006).

As a consequence of these concerns disabled activists and their organizations across the world became increasingly vocal in their dismissal of individual medical approaches during the 1960s and 70s; see for example Hunt (1966), De Jong (1979), Driedger (1989), Nordqvist (1972) Oliver and Campbell (1996), Shapiro (1993), Tateiwa (2010). Reflecting on their experiences of discrimination, disabled people focused on the organisation and structures of society rather than individual functional limitations or differences (Oliver, 1983; Zola, 1983).

## The social model of disability

The most radical challenge to official definitions of disablement came from a British organisation formed in 1974: the Union of the Physically Impaired Against Segregation (UPIAS). Drawing on personal experience and sociological insights, although none were trained sociologists, they redefined disability as 'social oppression' similar to that encountered by women, ethnic minorities, lesbians and gay men. In contrast to previous definitions which cited impairment as the main cause of disabled people's disadvantage they produced a socio-political definition that made the crucial distinction between the biological: impairment, and the social: disability. Hence 'Impairment' denotes 'Lacking part or all of a limb, or having a defective limb or mechanism of the body', but 'disability' denotes:

'the disadvantage of restriction of activity caused by a contemporary social organisation which takes no or little account of people who have physical impairments and thus excludes them from participation in the mainstream of social activities' (UPIAS, 1976: 14).

Subsequently the restriction to 'physical impairments' was dropped to incorporate all impairments - physical, sensory and cognitive. This is because some conditions both congenital and acquired can affect all bodily functions, Cerebral Palsy and Multiple Sclerosis are two examples, and in a disablist society all impairments whatever their cause, have, to a greater or lesser degree, negative physical and psychological implications (Reeve, 2006). Also impairment specific labels may have relevance when accessing appropriate medical and support needs, but they are usually imposed rather than chosen and therefore socially and politically divisive (Oliver and Barnes, 1998).

Thereafter the UPIAS definition was adopted and adapted by national and international organisations controlled and run by disabled people including Disabled People's International (DPI) an international body for national organisations controlled and run by disabled people themselves. DPI's first world congress was held in Singapore in 1982 and attracted 400 delegates from

around the world. They agreed on a common programme: the empowerment of disabled people through collective political action (DPI, 1982). For DPI, the prerequisite for change lies in the promotion of grass roots organisations and the development of public awareness of disability issues. Its slogan, 'Nothing about is without us' (Charlton, 1998), has been embraced by disabled people's organisations around the world.

A major influence on disability activism in the UK and elsewhere was the American Independent Living Movement (ILM). The ILM emerged partly from within the campus culture of American universities and partly from repeated efforts by American disability-activists swelled by the growing numbers of disabled Vietnam War veterans, to influence US disability legislation. In the 1960s, some American universities had introduced various self-help programmes to enable students with 'severe' physical impairments to attend mainstream courses. This prompted some disabled students to develop their own services within the community under the banner of Centres for Independent Living (CILs) (De Jong, 1979).

Unlike conventional services for disabled people CILs are self-help organisations run and controlled by disabled people. They provided a then innovative programme of services designed to empower people with impairments for a lifestyle of their own choosing within, rather than apart from, the local community. The activities of the ILM had a significant impact on activists and policy makers around the world. CIL type organisations are now evident in many countries both rich and poor (Barnes and Mercer, 2006).

The 1970s also witnessed the introduction of various legislative measures and policy initiatives to address disability issues. In Britain, the Chronically Sick and Disabled Person's Act became law in 1970. The Act is widely regarded as the first piece of legislation in the world to introduce policies to improve equal opportunities for disabled people in community based services, education, housing and public buildings (Topliss and Gould, 1981). Three years later the US Congress passed the 1973 Rehabilitation Act, which included Section 504 prohibiting discrimination against disabled people in any federally funded



programme. The United Nations (UN) introduced its Declaration on the Rights of Mentally Retarded Persons in 1971 and the Declaration on the Rights of Disabled Persons in 1975. The latter states clearly that:

‘Disabled persons, whatever the origin, nature and seriousness of their handicaps and disabilities, have the same fundamental rights as their fellow-citizens of the same age, which implies first and foremost the right to enjoy a decent life, as normal and full as possible’ (UN, 1975, article 3).

The UN designated 1981 The Year of Disabled Persons and 1983-92 the Decade of Disabled Persons. Thereafter followed a series of similar initiatives: the first and second Asian and Pacific Decade of Disabled Persons (1993-2002 and 2003-20012), the African Decade of Disabled Persons (2000-2009) and the Arab Decade of Disabled Persons (2003 - 2012), largely as a result of persistent lobbying by disability activists and their organisations (Takamine 2006).

Inspired by growing disability activism and interest in disablement in policy circles during the 1970s, Oliver, a British disabled activist and sociology lecturer, coined the phrase ‘social model of disability’ in 1981. For Oliver the social model:

‘involves nothing more or less fundamental than a switch away from focusing on the physical limitations of particular individuals to the way the physical and social environment impose limitations upon certain categories of people’(Oliver, 1981: 28).

It is therefore an aid to understanding which entails the adoption of the following principles. First, a social model perspective does not deny the importance or value of appropriate individually based interventions, whether be medical, re/habilitative, educational or employment based. Instead, it draws attention to their limitations in terms of furthering disabled people’s empowerment. Second, it is an attempt to shift attention away from the functional limitations of individuals onto the problems caused by disabling

environments, barriers and cultures. In short, the social model of disability is a tool with which to provide insights into the disabling tendencies of contemporary society in order to generate policies and practices to facilitate their eradication.

A notable example was developed by the UK's Derbyshire Centre for Integrated Living (DCIL) in 1985. In a paper inspired by a 'social barriers model of disability', Davis describes how DCIL implemented a comprehensive 'operational framework' for service support based on seven needs and priorities formulated by disabled people. These include: information, peer counseling and support, accessible housing, technical aids and equipment, personal assistance, accessible transport and access to the built environment (Davis, 1990: 7). Social model thinking was also instrumental to the development of Disability Equality Training (DET) courses devised and presented by disabled people. Aimed at professionals and practitioners these courses focus on environmental and social barriers to generate possible solutions (Gillespie-Sells, and Campbell, 1991). This is in contrast to Disability Awareness Training presented by non-disabled professionals that tend to reaffirm disability as an individual problem with the use of simulation exercises (French, 1996).

Although the social model has been criticised by both academics and some disabled people for its emphasis on environmental and social structures and neglect of impairment related concerns (Shakespeare and Watson, 2001; Shakespeare, 2006; Tremain, 2002), it has had considerable influence in the UK and beyond. The British Government formally adopted a social model definition of disability in 2005 (PMSU, 2005) and subsequently most disability state and voluntary organisations have now adopted this approach (Oliver and Barnes, 2006; Shakespeare, 2006). Social model thinking is also evident in policy statements and documents at the international level. In 1993, the UN produced the Standard Rules on the Equalisation of Opportunity for People with Disabilities. This document outlines a radical programme for governments to follow in identifying and securing equality for disabled people (UN, 2003/4).

The European Union sanctioned the social model of disability in its policy Action Plan of 2003 (Commission of the European Community, 2003: 4).

A social model played a key role in the Rethinking Care from Disabled People's Perspectives sponsored by the WHO's Disability and Rehabilitation Team. This was a two-year project and conference supported by the Norwegian Government that involved professionals, disabled people, and their families from all over the world (WHO, 2001a). The UN's Convention on the Rights of Persons with Disabilities and its Optional Protocol were adopted in December 2006. Negotiated over eight sessions of an Ad Hoc Committee of the General Assembly including representatives of disability organisations it marks the first human rights treaty of the 21st century. With 50 articles, the Convention is the most comprehensive document yet produced on the rights of disabled people (UN Enable, 2009). Furthermore, the WHO's recent International Classification of Functioning Disability and Health (ICF) to replace the much maligned ICIDH also claims to incorporate social model insights into its construction (WHO, 2001b, 2005).

### **The biopsychosocial model of disability**

Criticisms of the ICIDH on both conceptual and practical grounds, by disability organisations, researchers and some policy makers, resulted in the production of the ICF. After protracted discussions during the 1990s the ICF, or the ICIDH2 as it was originally known, was endorsed by WHO member states in 2001. Its development reaffirms the western scientific medical approach as the basis for classifying, measuring and treating 'biophysiological' conditions. Under pressure from disabled people's organisations however, they acknowledged that this approach ignores the role of environmental factors in the disablement process, but maintained that a social model approach was not 'amenable to empirical research and validation' (Bickenbach et al., 1999: 1178).

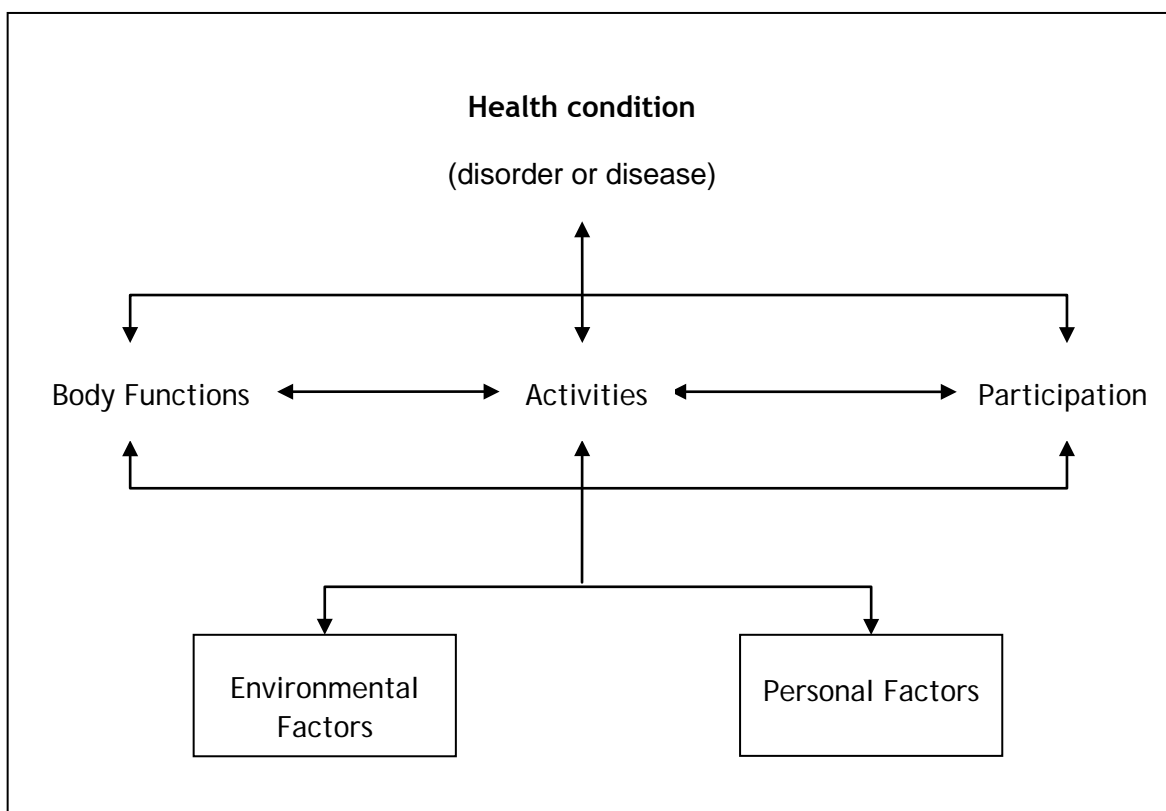
This resulted in a 'synthesis' of the medical and social models into a 'biopsychosocial model'. Thus the ICF promised a universally acceptable analysis based on 'a unified and standard language and framework for the description of health and health-related states' (WHO, 2001b: 3). It comprises

'components of health' rather than disease classifications with the aim of establishing 'a coherent view of different perspectives of health from a biological, individual and social perspective' (p. 20).

As in its predecessor the ICF identifies three levels of human functioning. It distinguishes (see Figure below): body functions and structures: impairments, both 'physical' and 'mental'; activities, participation, and contextual factors, which comprise 'environmental' and 'personal' factors. The coding scheme allows either positive (facilitating) or negative (barriers) outcomes, thus generating a large number of potential categories for data classification.

### Interaction between the components of ICF

Diagram 1. Interaction between the components of ICF. Source: WHO (2001b, p. 18)



Activity is defined as the execution of a task, based on a clinical assessment in a standardised environment, while participation covers a more 'social' aspect equated with capacity and actual performance 'in real life situations'.

The distinction between 'individual' versus 'social' perspectives reflects in many ways the ICIDH formulation. This raises questions about competing interpretations by users such as disabled people and professionals, as well within and across societies. Extra qualifiers of 'capacity' and 'performance' differentiate between an individual's ability to undertake a task or action, with or without 'assistive devices or personal assistance' (WHO, 2001b: 15).

The contextual (environmental and personal) factors refer to the 'complete background of an individual's life and living'. Persona factors include home, workplace and school and social factors relate to formal and informal social structures and services: transportation systems, built environment, government policies and ideologies. How far these indicators act as barriers or facilitators is based on user's reports. But different theoretical and methodological perspectives influence the choice of coding options of key dimensions such as 'support and relationships' (pp. 187-88), and attitudes that 'influence behaviour and social life at all levels (p. 190).

Further the range of 'personal factors' enumerated in the ICF indicates the scale of the task facing researchers and policy makers:

'gender, race, age, other health conditions, fitness, lifestyle, habits, upbringing, coping styles, social background, education, profession, past and current experience (past life events and concurrent events), overall behaviour pattern and character style, individual psychological assets and other characteristics, all or any of which may play a role in disability at any level.'  
(WHO, 2001b, p.17)

Such variables do lend themselves to quantitative analysis as advocated in the ICF. Yet the exclusion of such factors undermines the broad-based ambitions of the ICF.

Further, despite changes in terminology, the ICF retains similarities with the ICIDH. The link of impairment with a 'significant variation from the statistical norm' (WHO, 2001b: 221). As indicated earlier 'normality' is a contentious

concept. The ICF employs a much broader definition of disability that includes bodily limitations or impairment and social participation more generally. Disability is therefore the outcome of the: 'complex relationship between an individual's health condition and personal factors, and the external factors that represent the circumstances in which the individual lives' (WHO, 2001b: 17).

But while the ICF reifies social model insights that impairment and disablement varies across societal contexts, it ignores interaction between activities and participation, environmental and personal factors. The emphasis throughout is on a 'scientific' approach firmly grounded in western concepts and theories (Finkelstein, 1998; Pfeiffer, 2000; Baylies, 2002). This assumes that its concepts and measures are 'transculturally and linguistically applicable' (Bickenbach et al., 1999: 1185). As indicated above there is ample evidence that assumptions about a 'normal' health condition vary within and across different cultures. Significantly, the ICF is promoted as 'an essential tool for 'identifying and measuring' the effectiveness of rehabilitation services (Üstün et al., 2003: 567), rather than of wider social exclusion.

Yet despite its continued promotion by the WHO, UN and organisations such as the World Bank (WHO, 2011) there are growing doubts about its usefulness in terms of policy development:

'So, how do we answer questions about who is disabled or the prevalence of disability in a country or region? As a multi-domain, multi-dimensional, interactive and continuous phenomenon (as it is characterised in the ICF), we must specify which impairment domains qualify, to which degree of severity. Different prevalence rates flow from different decisions. If we are interested in any impairment domain, to any degree of severity, then prevalence is roughly universal - a conclusion of no use to policy makers whatsoever. If we restrict our scope to specific domains and severity levels, then our prevalence levels will differ accordingly. But these decisions cannot be made conceptually or scientifically, they are political. The scientific

approach in a word, does not solve the problem the policy analyst needs to solve' (Bickenbach 2009: 120).

Despite these concerns, in common with the social model the ICF draws attention to the impact that the physical and cultural environment has on disablement. Hence contemporary infrastructures are now viewed by disabled people and their organisations as a visible example of societal neglect of disability issues, and the result of architects and designers 'complete denial of bodily diversity and difference' (Imrie, 2000: 200). The following section focuses on one proposed solution to this problem: universal design.

### **The universal design debate**

The growing emphasis on an inclusive approach to make the internal and external features of the physical and cultural environment accessible to disabled people has resulted in the elevation of debates about the importance of accessibility and generation of accessibility and universal design (Imrie, 1996). But in order to avoid what Welsh (1995: 2) refers to as 'potent symbols of separateness' that stigmatise particular sections of the community in discussions about accessibility and promote innovative solutions, attention has centred on the concept of universal design.

The phrase 'universal design' was coined by Mace (1998) to refer to: 'The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation, specialist design' (Centre for Universal Design, 2011: unpagged). It has also been defined as a movement that approaches the design of the environment, products and communications with the widest range of users in mind (Gossett et al., 2009). This design for all approach is widely linked to discourses of social inclusion and human diversity. The general aim is to improve the physical and social environment and therefore reduce the need for 'special' provision and 'assistive technologies' (Steinfeld, 2006: 1). Therefore design processes address how products, communication systems, buildings, public utilities, amenities and spaces can be produced that are both functional for the greatest number of users and aesthetically acceptable (Welsh, 1995).

Advocates of universal design acknowledge that poorly designed products and environments are discriminatory and disable large sections of the population at various stages in the life course. People with impairments and older people are particularly disadvantaged. For example, Wylde et al, (1994) suggested that as many as nine out of ten people are likely to experience 'architectural discrimination' (Hanson, undated: 10) at some stage in their lifetime. Universally designed products and environments are based on the following seven principles:

- Equitable use: The design is useful and marketable to people with diverse abilities.
- Flexible in use: The design accommodates a wide range of individual preferences and abilities.
- Simple and Intuitive: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
- Perceptible Information: The design communicates necessary information effectively to the user, regardless of their sensory abilities.
- Tolerance for Error: The design reduces hazards and adverse consequences of accidents.
- Low Physical Effort: The design allows efficient usage with minimum effort.
- Size and Space for Approach and Use: Appropriate space is provided to enable comfortable and effective use for anyone regardless of physical and sensory ability.

Adapted from: Centre for Universal Design, 2011

Universally design artifacts, products and infrastructures must therefore be barrier free and accessible to all regardless of age, impairment, gender, ethnicity and sexuality. By acknowledging the diversity of the human condition universal design promotes the creation of physical and cultural environments that enable everyone to carry out their daily activities in comfort and safety without undue hindrance and inconvenience. A commonly cited example is a



universally designed building with ramps, lifts and automatic doors that will not only be easily accessible for wheelchair users but also for people with baby carriages, shopping trolleys and luggage (Lepofsky and Graham, 2009). Therefore universally designed products and environments must go beyond the minimum requirements of particular user groups but seek to identify 'how a politically mandated and socially desirable value can be embodied by the design disciplines' (Welsh, 1995: 262).

## Discussion

Since the middle of the last century our understanding of disability has gradually shifted away from assumptions about the functional limitations of particular individuals and groups towards the way societies are organised. Whilst individual impairment and long term illness is undoubtedly an important factor in the disablement process, attention is increasingly turning toward physical and cultural infrastructures as a cause of both impairment and disability.

Estimates suggest that only around two to three per cent of impairments are present at birth. Most disabling conditions are due to a variety of social causes including poverty, pollution, accident, violence and war, and acquired at various stages in the life course. It is also the case that the more technically and socially advanced societies become the more impairment and disability they create. Due to several factors such as relative affluence, medical advances and comprehensive welfare systems, people in wealthy states live longer. The incidence of impairment increases significantly with age (Priestley, 2003). Indeed, global estimates suggest that the incidence of impairments in all societies is increasing and that as many as one billion people, 15 percent of the world's population, are disabled (WHO, 2011).

As indicated earlier the physical and cultural environment is a key element in the disablement process. In recognition of this fact most governments especially in wealthy states have formulated and introduced legislation and regulations which on paper at least aim to address this problem. In the UK for instance, the 1995 Disability Discrimination Act (DDA) introduced a legislative

requirement that 'reasonable adjustments' be taken to remove the physical barriers facing disabled people, including new development plans. But what constitutes a 'reasonable adjustment' remains a contentious issue and ten years later less than 20 per cent of public buildings in London were rated as mobility-accessible, and 80 per cent of pubs, clubs and restaurants and other leisure venues rated as less than satisfactory (DRC, 2005). Other shortfalls included the lack of accessible toilets, ranging from only 10 per cent in restaurants to 55 per cent of cinemas (Scope, 2004).

A similar unsatisfactory situation exists for Britain's housing stock (Hemingway, 2011) and transport systems (Jolly, Priestley and Matthews, 2006). Since 2004, the implementation of the DDA physical access provisions and revised building regulations increased the pressure to improve access, particularly for leisure and entertainment venues. Even so, implementation is uneven, and a fully accessible physical environment remains a long-term goal (Barnes and Mercer, 2010: 118).

Research across Europe (Prideaux, 2006), Australia and New Zealand (Gleeson, 2001) paint a similar picture. Not only have there been a consistent failure in these countries to implement access regulations to prevent 'the production of inaccessible urban environments' (Gleeson, 2001: 256), but also 'organised irresponsibility' regarding enforcement strategies and the introduction of 'get our clauses' in official regulations (Imrie, 1996). The situation is equally dire in poorer nations of the world. One disabled commentator reports that structural inaccessibility 'lack of ramps, curb cuts, elevators' for example, is endemic throughout so called 'developing' countries (Charlton, 1998: 106).

It is notable here that Article 9 of the UN's Convention on the Rights of Persons with Disability states:

'Inevitably however the emergence of universal design has generated considerable debate amongst academics and practitioners. Critics argue that the definition and principles of universal design are too general and lack clarity. The generality

and lack of bench marking in the definition and principles of universal design are said to be too broad and contradictory. Equitable in Use is a social justice goal whilst Flexibility in Use is a design goal and the remaining principles focus on performance. For Crews and Zavotka (2006) too much emphasis is given to physical functioning. Concerns have also been raised about issues such as cost, participation outcomes and social change. All of which have been linked to the failure to embrace a more 'authoritative definition of disablement' such as the ICF' (Steinfeild, 2006: 8).

The lack of bench marking in the principles of universal design has also been cited as a major problem. Notwithstanding that the thinking underpinning the principles are general and therefore may be useful for product design for items such as mobile 'phones and information technology, they are less so though for other areas and items. These include architecture, graphic design and urban planning'. Indeed other guidelines have been produced with which to address these issues, but as yet no guidance has emerged on how to make these compatible. Other concerns revolve around the lack of benchmarking, measurement and examples of best practice against which universally designed items and outcomes might be judged (Steinfeld, 2006: 3).

Moreover, most critics argue that the thinking underpinning the concept of universal design overlooks the problems associated with widespread acceptability due to questions of compatibility and implementation. Steinfield (2006) for example notes that the notion of universal design implies that there is a single universally acceptable solution to all design problems. Such an assertion is both 'utopian and simplistic'. It is also unachievable due to ethnic and cultural divisions within and across nation states as well as the diverse needs of different impairment specific groups (Gossett et al., 2009: Shakespeare, 2006; Steinfield, 2006).

Changes to the mainstream environment that address the access needs of one section of the disabled population may pose problems for others. Equally

important is the assertion that 'different people with the same impairment may require different accommodations because everyone experiences their own impairment differently' (Shakespeare, 2006: 46). In terms of compatibility, whilst bright lighting may be a suitable accommodation for people with certain visual impairments, it can pose significant problems for people with epilepsy or seizure disorders (Gossett et al., 2009: 445). Indeed, the widespread acceptability of universally designed products and environments may prove to be an elusive ideal no matter how thoughtful designers and architects attach to their designs.

Nevertheless the debates that have emerged since the inception of the universal design concept have certainly raised the bar in discussions about barrier removal and the systematic exclusion of disabled people from the mainstream of economic and social activity. But as indicated earlier the primary keys to independent living for disabled people are peer support and personal assistance. In other words access for all is only possible with appropriate human involvement.

'To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure persons with disabilities access on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communication technologies and systems, and systems and to other facilities and services open or provided to the public both in urban and rural areas' (UN Enable, undated and unpagged).

The Convention is designed in an international law context and sets out the duty of nation states to protect human rights. It is said to be legally binding on any country that ratifies it. At the time of writing it has been signed by 149 countries and ratified by 101 states (UN. Enable, Undated).

Whether the Convention will be more successful than previous legislative attempts within and across nation states to address environmental barriers is as yet unknown. What is clear however is that the economic, political and cultural

implications of disablement both nationally and internationally can no longer be ignored. The interdependence of individuals, groups, populations and nation states is now increasingly evident due to the quickening pace of globalisation, and the succession of economic and political crises that have dogged the world economy since the 1970s. At the same time the world faces unprecedented challenges due to growing populations, rising inequality and the unfettered exploitation of finite and diminishing environmental resources (Harvey, 2010).. Consequently the struggle for a fairer, just and sustainable world system is increasingly urgent. Clearly a major component of this endeavour is the development and production of barrier free infrastructures, artefacts and cultures at the local, national and international levels. It is a struggle that must involve everyone, but especially those involved in the funding, planning, design, development and production of physical and cultural environments, if a global society accessible for fit for all is to be a realistic and achievable goal.

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\* Also available at the Disability Archive UK: <http://www.leeds.ac.uk/disability-studies/archiveuk/index.html>

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