Critical Design in Universal Design Settings: Pedagogy turned upside down

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Abstract

Universal design thinkers are needed now more than ever. The world is facing one humanitarian crisis after the other, forcing people to flee their homes and resettle elsewhere without knowing anything about the local language, traditions, and way of life. Moreover, an ageing population is in need of (housing) design that facilitates long-term accessibility and hence homeowners 'ageing in place' safely without losing their independence. Moreover, nations such as Japan, Spain, and Norway have made diversity and inclusion part of their national political agendas to ensure that future products, buildings, and exterior spaces, are inherently accessible to all. Taking all of this together, it is imperative that the next generation of designers is informed about and skilled at dealing with future challenges and demands, however complex they might be.

Originally developed as a powerful tool for designers, architects, and others to explore 'extreme environments', such as hospitals and prisons, and the ways in which objects impinge on existential wellbeing, the critical design method is now gradually being adapted and applied to the field of universal design. Two series of workshops have been conducted to test and further develop this way of thinking about design for educational contexts. The purpose of this paper is to describe the process of applying the critical design method to various universal design contexts, and to discuss the results thus far. Furthermore, the paper examines to what extent critical design is an appropriate method for questioning and improving the field of universal design.

Key words

critical design, universal design, design methods, educational practises, workshops, wellbeing

Introduction

1.1 Universal Design

According to Mace, who is credited with coining the term in the mid-eighties, 'universal design' (UD) is "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Centre for Universal Design, 2018). In the last ten years, however, UD as a design code or philosophy has been broadened in

terms of its scope to include the wider issues of subjective values such as social inclusion and self-actualisation (Zöller & Wartzack, 2017, p. 55-69). Thus, a more recent and accurate definition is as follows: "A process that enables and empowers a diverse population by improving human performance, health and wellness, and social participation" (Steinfeld & Maisel, 2012, p. xi). Zöller and Wartzack think along similar lines, recently proposing that UD should prioritise the objective and subjective well-being of users (2017, p. 55-69). Moreover, because there is currently no end to the needs, wants, and desires of the public as relating to improved human performance, health and wellness, and so on (Steinfeld & Maisel, 2012, p. 90) – nor will there ever be – future UD thinkers[1] should always keep their knowledge of UD current, this paper argues. Among other things, this means that academia will have to deliver consistently outstanding teaching and learning outcomes. This will be undertaken in order to equip the universal design thinkers of tomorrow – be they designers, architects, engineers, or other professionals – with novel ways of approaching the UD process.

Further; what if design educators were to turn the key terms and concepts relating to UD upside down (metaphorically speaking)? This could be undertaken by implementing, early in the design process, a CDM that makes it possible for students to focus on "what it means to design for a fundamental form of being human", rather than "what the thing we design is intended to do as we use it" (Torkildsby, 2014, p. 30). Would students have different learning outcomes, or even a deeper understanding of what it means to be human in the physical environment? Furthermore, can critical design thinking and a certain amount of provocation provide them with alternative starting points for creative thinking, and thus add more tools to their problem-solving toolboxes (Torkildsby, 2017)[2]?

1.2 Existential designial analysis; the critical design method

Existential designial analysis (EDA) is, in short, a critical design method (CDM) that has been developed as an alternative way of thinking about design in 'extreme environments': those that people are unable to leave – for either physical or mental reasons, and temporarily or permanently – and which do not support what is considered to be a 'normal' state of existence (Ibid., p. 22), such as intensive care units (ICU) and remand prisons. While traditional design methods such as those of Archer (1965) and Jones (1970) merely address the function(s) of a product, service, system, and/or process, the CDM focuses on the impact that the product has on the user while they are using it. In other words, instead of asking "what does a prison uniform do?", for example, the emphasis is on "what is a prison uniform as a design?" (Torkildsby, 2014, p. 30). Moreover, employing it during the initial phases of a design process enables the designer to shift focus, from "analysis of the functionality of a design in use, e.g. by performing a functional analysis, to analysis of the form of

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[1] Torkildsby (2017) considers UD to be a process rather than an end result, hence the term 'universal design thinkers'.
[2] The main findings reported in this paper were originally presented at the E&PDE conference in 2017.

being human that a design in use defines" (Ibid., p. 7). In so doing, the designer is able to open up the design brief and examine it from perspectives that may otherwise be overlooked.

The CDM is rooted in 'critical design' – a term that builds on the attitudes of the Italian radical design school of the 1960s and 1970s, but was first coined by Dunne in 1999. Dunne and Raby argue that 'design can be described from two perspectives; 'affirmative design' and 'critical design'. Affirmative design "reinforces how things are now" as it conforms to cultural, social, technical, and economic expectations (Dunne & Raby, 2001, p. 58), and aptly describes the majority of design processes. Critical design, however, "rejects how things are now as being the only possibility, [and] provides a critique of the prevailing situation through designs that embody alternative social, cultural, technical or economic values" (Ibid.). Malpass describes critical design as an *affective*, rather than *explanatory,* practise because it "opens lines of inquiry as opposed to providing answers or solutions to questions or design problems" (2017, p. 41). The purpose of critical design is, in short, to make people think and so raise awareness, expose assumptions, provoke action, and spark debate (Dunne & Raby, 2018). Dunne, moreover, relates critical design directly to the critical theory developed by the Frankfurt school in the 1930s – which, in brief, aimed to not only understand the world but challenge that understanding (Gulliksson, 2015, p. 276) – and quotes Geuss's description of critical thinking: "Critical theories aim at emancipation and enlightenment, at making agents aware of hidden coercion, thereby freeing them from that coercion and putting them in a position to determine where their true interest lie" (Dunne, 2006, p. 150; Geuss, 1981, p. 55-56). Critical design has been used in recent decades to examine social, political, economic, and environmental issues in society: See, for example, the iconic *Faraday Chair* (1997) of Dunne and Raby, which provides shelter from the electromagnetic fields that are increasingly invading our homes (Dunne, 2005, p. 142-44), and Onkar Kular's *Hari and Parker* (2007), a speculative project that explores the increasing presence of domestic surveillance and information exchange (Kular, 2018). Similarly, Gavel et al.'s recent, Research Councils UK-funded project *Energy Babble* (2015) features an "automated talk-radio" plays various sounds and statements borrowed from various social media and online sources as a way of reflecting and commenting on the existing state of energy use in the UK (Gaver et al., 2015). These projects are just the beginning, according to the innovation and design-thinking researcher Mickahail, who claims that critical thinking and creative thinking must work together in order to ensure that innovation takes place in the design thinking[3] process (2018).

The CDM consists of a three-step design approach, which in turn is presented as a functional design manual – ready for use. The three steps are intended to guide a designer through the process of generating 'critical design examples' (CDEs) (Torkildsby, 2014, p. 20). According to Sanders, critical design uses 'probes' as "ambiguous stimuli that designers send to people who then respond to

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[3] 'Design thinking' was coined in the 1990s by David Kelley and Tim Brown of IDEO, and refers to a human-centred, structured process for innovation that can be applied to products, services, systems, etc. (IDEO, 2018).

them, providing insights for the design process" (Sanders, 2006, p. 7). This correlates well with the intended function of CDEs, i.e. highlighting problems in extreme environments in order to identify the complications that may arise if this aspect of design thinking is ignored – hence, this is considered to be the 'dark' approach to design thinking. In other words, CDE are primarily intended to be used in problem-solving processes, such as the planning of a new hospital or prison, in order to foster innovation among everyone involved in the process. Thus, designers obtain improved knowledge of the relationship between humans and physical objects in extreme environments when creating CDEs, which function in the same way as critical artefacts, speculative design objects (Bowen, 2009; Dunne & Raby, 2013), and 'provotypes' (Mogensen, 1992; Boer & Donovan, 2012). This is to say that, by engaging with them, designers are challenged to leave their comfort zones and think outside of the box in order to find better solutions to design problems. Lenskjold has studied the use of critical artefacts, provotypes, and other forms of provocative design from an anthropological perspective, suggesting that critical artefacts, which function as transitional devices at different stages of a design process, are "objects of mediation between heterogeneous assemblages of stakeholders, contexts and concerns" (2011). This line of thinking perfectly matches the purpose and significance of CDEs within the framework proposed in this article. Bowen has suggested applying a similar method, termed 'critical artefact methodology', in participatory design and co-design processes. This research explores the effects of critical artefacts being used to provoke stakeholders to engage with artefacts, which in turn leads to reflection on the assumptions that underlie what is considered to be possible (2009, p. 190). In short, Bowen's conclusion is that even though critical artefact methods are not universally applicable, they are well-suited to "imaginative, open-minded stakeholders, 'in-tune' with the possibilities of novel situations" (Bowen, 2009, p. 217-18). This is particularly the case for designers, this paper argues, who may develop and adapt critical artefact methods within their own professional practice.

2   APPLYING THE CDM TO EXTREME ENVIRONMENTS

As is discussed above, the CDM was first developed with extreme environments, such as ICUs and remand prisons, in mind. In order to obtain extensive knowledge of these institutional environments to complement what has already been established through literature, interviews, etc., observations in the environments were conducted. The key issues were then identified, assessed (i.e. compared with 'reality' – the current research context), defined, and classified within a system (Torkildsby, 2014, p. 288-289). Furthermore, the theoretical framework was re-formulated in relation to EDA so as to be more practical, then formed into the three-step approach that in turn was compiled in a design manual. As a way of testing, exemplifying, and disseminating the CDM, eight workshops involving approximately 80 students were conducted in various design schools in Scandinavia in 2011 and 2012. Hundreds of CDEs were generated during the workshops, six of which are discussed in this article (see Chapter 3 of Torkildsby's *Existential design – Revisiting the "dark side" of design thinking* for more examples).

3   WORKSHOP SERIES #1 – BRINGING THEORY INTO PRACTICE

3.1 Structure

Although the length of the workshops varied between one and four days, the overall structure – the order of the activities and the amount of time spent on Steps 1-4 – remained the same, aside from Step 1 during those workshops which had a large number of students. Lunch breaks and so on were agreed upon following discussion with each class. Consent forms were signed and handed in before the end of the workshop – with participants able to withdraw their consent at any time – so that the data collected (pictures, sketches, quotations, etc.) would be available for use later in the project. It should be noted that the tutor shifted between the active role of a teacher, providing guidance when needed, and the passive position of an observer, 'drinking in' as much information as possible. The following example (Table 1) is from a one-day workshop:

Table 1. Workshop structure (Torkildsby, 2017).

Time	Activity	Step
09:00-09:30	Welcome and introduction by the tutor, followed by brief student introductions and an overview of the workshop	1
09:30-09:40	Introduction to functional analysis and the CDM, as well as a brief run-through of the differences and similarities between these two approaches to design	2
09:40-10:25	Presentation of four fictional settings, along with a demonstration of using the CDM by applying the three steps	3
10:25-11:00	Discussion and presentation of CDEs, including visual material from the field of critical design for inspiration	4
11:00-15:45	Presentation of the assignment, with the students being divided into groups (with a maximum of five in each), and the beginning of the group work	5
15:45-16:30	Presentation of the final concepts – the CDEs – followed by a discussion and summing-up of the workshop	6

3.2 Participants

All of the participants were students of some form of design; some were working towards a degree in textile design, while others possessed a strong background in industrial design. The participants came from both the BA and MA levels, and both genders were represented. Many nationalities were represented as most of the schools accept international students.

3.3 Procedure

The students were challenged to reflect on and discuss the reality of existing in an extreme environment prior to commencing work on the task. The scenarios that were touched upon included a person undergoing care in an ICU regaining consciousness after being sedated, and dreaming about being abducted and tortured by aliens or facing a firing squad, despite being in safe hands at the hospital. Similarly, in the context of prison, the students explored the idea of people being held on remand being deprived of (almost) all of their freedom as a means of punishment, despite the fact that a central tenet of justice systems is that the accused should be considered to be innocent until proven otherwise. The students created CDEs based on these ideas, examining everything from how being strapped to a bed in an ICU makes an individual feel exposed and fragile to the fact that those in remand prisons are vulnerable to violence, sexual abuse, and torture.

The students then used the three-step CDM to develop CDEs in response to given problems. Half of the students developed curtains, prison jumpsuits, bedding, or door handles for remand prison cells, while the other half created clothing, bedding, room dividers, or bedside lamps for ICU patient rooms. The creative process for tackling this assignment generally unfolded as follows: Discuss; reject the idea of designing something that is *affirmative* rather than *critical* and *explanatory* rather than *affective* (Dunne & Raby, 2001, p. 58; Malpass, 2017, p. 41); create a fictional setting (i.e. a fictional person and environment) as a basis for further development. Next, accept the existence of fundamental differences between traditional design thinking and the CDM; sketch; drink coffee or tea; discuss; decide on a concept to develop into one or more CDEs; eat lunch; sketch; possibly create one or more prototypes; discuss; present the outcome. Most of the groups produced more than one CDE, but all had to select one to present. The students were, for the most part, surprised by what they had achieved by the end of the day: "But this seems to be upside down?!"; "I'm not that into critical design – at least not until now, but I sure like this way of working with fiction to prove a point"; "Actually, I'm a bit ashamed that we came up with this…" (Torkildsby, 2014, p. 270).

The 'dark' way of thinking evoked both reflections and emotions in relation to the environments being discussed. One student whose grandmother happened to be in an ICU at that time, for example, understandably felt appalled at the prospect of developing CDEs that involved the idea of harming a bedridden person. That student, however, arrived the next day and was heard to say, among other things, "So we're not supposed to be 'nice'?!" and "Yesterday I felt sick. Today it's just fun!" (Ibid., p. 246). The students came from a wide variety of schools and backgrounds, and felt that, regardless of the design method that they commonly used in their respective fields, this 'dark' way of thinking "doesn't hurt anyone" (Ibid., p. 255); rather, it opens one's eyes, even if one does not deal with critical design on a daily basis.

Figure 1. Students' work. From left to right: ICU bedding made out of metal sheets, to – quite literally – anchor the patient to their bed; a prison jumpsuit to cover the inmate's body, including the head, while leaving their buttocks exposed; a door handle for a remand prison cell that is designed so that the cell shrinks every time the prisoner tries to open the door (Torkildsby, 2017).

3.4 Trends and reflections

The most apparent trend discerned during the workshops was the significant differences between the students' approaches to the task. Those participants with a background in problem solving – in the sense that a process begins with the definition of a problem, and this is followed by a functional analysis or similar to define functions(s) – such as product and industrial design students tended towards being 'method- and concept-oriented', and generally created a concept and worked from there (Ibid., p. 257). Those participants with a 'material- and technique-oriented' approach to design – such as the textile and fashion design students – on the other hand, started the process by selecting a material and technique. They then created a method and concept that was a critical version of the already-existing object, rather than selecting materials based on a specific concept (Ibid., p. 196). It should be noted, however, that the resulting CDEs show that one of the two working methods did not produce 'more critical' design examples than the other; i.e. the CDM appears to work perfectly well for both design approaches.

The participants in the first two workshops found it difficult to begin work on the task of designing the CDEs, but solved this by starting the process with the creation of a fictional setting. The fictional people and environments provided the students with a narrative to work from and a framework for the CDEs (Ibid., p. 170; 189). From the third workshop onwards, however, the students were encouraged to develop settings in groups for their CDEs, and post-workshop discussions with the students revealed that this approach made the CDM less abstract and easier to grasp and subsequently apply.

Another observation made during WS1 (Workshop Series #1), was that the students approached one- and four-day workshops differently. During one-day workshops, the students generally rushed to settle on and carry out a single concept, but during the multi-day workshops the students took more time to explore different ideas and concepts before settling on one. Four one-day, one two-day, two three-day, and one four-day workshops were conducted as part of WS1, and it was concluded that three days provided sufficient time for the participants to grasp the concept,

experiment, and develop several acceptable concepts in a suitable manner. This also prevented them from spending too much time on fictional settings, stylised renderings, building models, and supplementary films, as was the case during the longer workshops (Ibid., p. 244).

The students felt that eight hours was an acceptable length for the one-day workshop to function as an introduction, with one describing it as "a little like a vitamin injection" (Ibid., p. 215). A deeper learning experience and longer-lasting learning outcome, however, was felt to require more time in which to think about (and, moreover, *re*-think) and play with the material before settling on CDEs (Ibid., p. 168). This suggests that a longer design process resulted in more learning, but the time spent on creating the CDEs appeared to be less related to how critical the CDEs were – although whether this was due to talent or luck is difficult to say with any certainty at this point. It should be added that, although it was to be expected, the students with more experience of design methodology and designing (on any scale), such as many of the Master's students who participated in the workshops, generally completed the workshop assignment relatively efficiently. In comparison, some of the second-year Bachelor's students, for example, simply spent more time on the same tasks. This insight, in turn, informed decisions regarding future workshop participants.

3.5 Results

The students were free to choose the medium with which to present their result, and so the CDEs took the form of rough black and white sketches, colourful cut-and-paste illustrations, detailed scenario descriptions, simple mock-ups, elaborate models, short films, verbal presentations, and role-plays. Without doubt, however, the learning outcomes were much more important than any physical results produced, and the discussions at the end of each workshop revealed that most of the students felt that this way of thinking design was liberating in relation to their world of problem solving. Moreover, it seemed that the students (mostly) had fun developing CDEs: "This is kind of bad and fun at the same time" (Ibid., p. 216); "It's fun to be a bit artsy…" (Ibid., p. 246).

With regard to the presentations at the end of each session, less finished or polished CDEs were generally the product of more (critical) questions having been asked and fruitful discussions held, leading, naturally, to a better understanding of the CDEs and more knowledge being generated about critical design in general. Similarly, the more loosely structured presentations felt more comfortable in the context of the class: gathering all of the participants around a table and talking informally about what each group had achieved – along with how and why – rather than 'selling' the result with intricate renderings and flashy models, appeared to be central to opening up discussions (Ibid., p. 199).
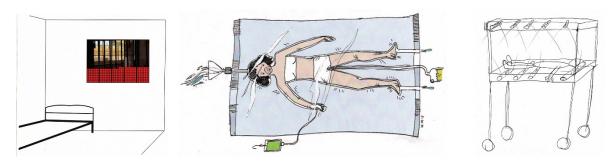
Figure 2. CDEs that were created during WS1. From left to right: Prison curtains that slowly block the view of the inmate; transparent bedding for use in an ICU ward to fully expose the patient; hospital bed dividers to put the patient 'in the spotlight', rather than acting as protection (Torkildsby, 2017).

4   APPLYING THE CRITICAL DESIGN APPROACH TO UNIVERSAL DESIGN

The physical environment, which includes housing, products, transportation systems, and buildings, is typically designed for the able-bodied; as Norwegian Design and Architecture states on its website, "Most products and services are generally designed for the average user – a typically healthy, right-handed, white, young male" (2018). Thus, those who have difficulty in walking or suffer from colour blindness, cognitive disabilities, and even incontinence fall outside this definition. Initially appearing during the civil rights movements of the 1950s, then subsequently applied in, among others, the field of architecture (Goldsmith, 1963) and in relation to commercial products and information technology (Mace, Hardie & Place, 1991), UD is a relatively new concept in design education. Viable methods of teaching have been established (Clarkson, Coleman, Hoskin & Waller, 2007; Vavik, 2011) but, as Denizou states, teaching UD requires a foundation of design methods that are based on, among other things, creation and simulation exercises (Denizou, 2016, p. 113). In addition, Zöller and Wartzack conclude that UD needs to consider not only physical ability in the search for well-being but the overall satisfaction of users – including motivations relating to and feelings towards a product or environment (Zöller, & Wartzack, 2017, p. 57). This is why the CDM should be a welcome contribution to the field; a means of exploring concepts in more detail and, most importantly, the fundamental relationships between people and objects (Heidegger, 1971; Borgman, 1984; Torkildsby, 2014).

5   WORKSHOP SERIES #2 – BRINGING THEORY INTO PRACTICE

5.1 Structure

The second workshop series consisted of three half-day workshops, all of which shared the same overall structure – i.e. the order of activities as well as the time spent on each part – and were identical to those of WS1 as regards administrative aspects.

Table 2. Workshop structure (Torkildsby, 2017).

Time	Activity	Step
12:30-12:45	Welcome and introduction by the tutor, followed by brief participant introductions and an overview of the workshop	1
12:45-13:15	Introduction to the CDM, including a brief explanation of how to apply it during the design process and a discussion and presentation of CDEs	2
13:15-15:45	Presentation of the assignment, with the participants being divided into groups (with a maximum of three in each), and the beginning of the group work	3
15:45-16:30	Presentation of the final concepts – the CDEs – followed by a discussion and summing-up of the workshop	4

5.2 Participants

The eight participants in the first workshop were researchers from a Scandinavian rehabilitation engineering and design research institute, while the twenty-five of the second and third workshops were occupational therapy Master's students from Norway. The participants were aged between 20 and 60-something, and both genders were represented.

5.3 Procedure

As in the previous workshops, the participants developed CDEs to solve a given problem, creating speculative design proposals for staircases, headphones, door entrances (i.e. frame and door), smartphones, and E-textiles. Because of the limited time as compared to WS1, there was less opportunity to discuss the physical environment prior to the beginning of the creative process, and the fictional settings were created in advance by the author to save time during the workshop. The fictional settings included descriptions of physical/psychological dilemmas, several examples of which are as follows: "Caroline (67 years old) has lost her peripheral vision and has poor depth perception, making crossing the road and going down stairs very difficult" (design task: staircase). "Elizabeth (48 years old) suffers from urinary incontinence, and as a result often avoids public transport due to the fear that the bus or train might not have an operational toilet – or any toilet at all" (design task: E-textiles). "Tom (37 years old) was diagnosed with multiple sclerosis 12 years ago, has poor balance, experiences difficulties in walking, and finds that he bumps into things every now and then" (design task: door entrance). A portrait of the fictional person accompanied the texts to further stimulate the imaginations of the participants.

The two groups had different ways of approaching the task, with the researchers performing a miniature version of a traditional problem-solving process, featuring ideation and concept development towards a result, while the Master's students quickly decided upon a solution. In addition, the students had a tendency to create CDEs that featured an element of cliché and pastiche, rather than letting the viewer, in the words of Dunne and Raby, "experience a dilemma, [and so decide for themselves;] is it serious or not? Real or not?" (Dunne & Raby, 2018). Despite their differences, the participants worked diligently throughout the workshop, and the topics that were discussed ranged from the extent to which our environments drive and direct our possibilities and actions to how the CDEs could be used to fuel a creative process – among not only designers, but also occupational therapists. Just as in WS1, the participants were positive regarding their experiences, aside from one who felt that this way of working was childish and a waste of time. To quote some of the participants: "This is like anti-universal design"; "What a great way to kickstart a project!"; "The critical design examples remind me of 'design probes' and 'provotypes'" (Gaver, Dunne & Pacenti, 1999; Mattelmäki, 2006; Mogensen, 1992; Boer & Donovan, 2012).

Figure 3. A visual impression of the workshops (Torkildsby, 2017).

5.4 Trends and reflections

That the researchers from the rehabilitation engineering and design institute worked differently to the Master's students from the occupational therapy programme was, as is discussed above, to be expected due to the differing backgrounds of the two groups. However, the extent to which the latter were less effective due to having little or no experience with design methods – and speculative design approaches, for that matter – and less honed creative/artistic skills in general is unclear. Similarly, whether this related to the limited time and consequent brief introduction to the theme, or a combination of these, is also uncertain.

This was the first time the fictional settings, i.e. the dilemmas of Caroline, Elizabeth, and so on given above, were presented to the participants prior to them commencing work on the task, and all three groups seemed to embrace the idea and benefit from it in terms of time. They quickly began to work, although in retrospect it is difficult to say whether this 'lost' time was actually what the participants needed in order to reflect more on the subjects in question and obtain a better understanding of the material (this realisation, moreover, provided insights regarding future workshops.) With regard to the element of time, and as WS1 showed, one-day workshops seemed

to function as a 'vitamin injection', meaning that the half-day workshops barely offered a taste of the concept at its core. It is hoped, however, that a seed was planted in each of the participants, and that they at least know where to find more information about this way of thinking about design if they wish.

It should also be noted that all three groups conducted relevant discussions, both within each group and with the tutor; these revealed that, regardless of background, the participants were able to see the CDM as a way of "learning something new about something old", in the words of one of the Master's students. This supports the findings of WS1 – that the learning outcomes achieved as a result of hands-on experience seem to be much more important than the physical results produced.

5.5 Results

The CDEs were generally more 'half-baked' than those produced during WS1 and so less 'critical', which was to be expected due to the differing backgrounds of the participants and limited time available. This phenomenon was more apparent within the two groups of Master's students than the group of researchers, for the reasons discussed above. Furthermore, the ways in which the CDEs were presented varied from simple sketches to more detailed concept drawings and verbal presentations. The researchers produced relatively refined visualisations whereas the students presented sketches that were generally quite simple, again for the reasons discussed above.

With regard to the oral presentation of the CDEs, the students generally communicated their concepts in a way that reflected the time spent on developing them, i.e. simple black and white sketches and a few sentences. It is perhaps the case that the relatively short time allotted to the groups for developing their ideas meant that the presentations were as important for the learning outcomes of the participants as the element of actually creating their ideas. In other words, the oral presentations gave those who had not yet (fully) understood the concept a second chance – and, based on the murmurs of "aha!" that were heard during the presentations, principally expressed by the Master's students, this aspect of the workshop was strongly appreciated. It is often said in pedagogical contexts that "the whole is greater than the sum of its parts" (Burke, 2011) – a phrase supposedly coined by Aristotle, and one that suggests that the practice of presenting was valuable and worthy of inclusion in future workshops.
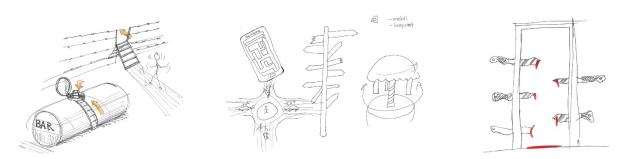
Figure 4. Examples of the CDEs that were created during WS2. From (top) left to right: A staircase, with a mandatory 'spinning drum stop' in front, so that every person entering the building is equally off-balance; various 'orientation-devices' to make users walk in circles; a door entrance that punishes those who do not walk straight when passing through it (Torkildsby, 2017).

6   DISCUSSION AND CONSIDERATIONS

This paper has presented the CDM and discussed how it can be implemented in design processes to expose assumptions, generate interesting questions, and discover new ideas. Incorporating this way of thinking into design education programmes would provide students with greater insight into what it means to be human in the physical environment and, more importantly, what might happen if they – the next generation of designers – do not take into account this aspect of designing. Furthermore, critical design methodologies, be they in the form of the three-step approach used in WS1 or the fictional settings of WS2, encouraged students (and, on one occasion, a group of researchers) to think outside the box – to not simply engage in 'affirmative design', i.e. design that "reinforces how things are now, [how] it conforms to cultural, social, technical, and economic expectations" (Dunne & Raby, 2001). As Einstein once allegedly stated: "The significant problems we face cannot be solved at the same level of thinking we were at when we created them" (Nolet, 2016, p. 80). Hence, it is not outrageous to say that the CDM is likely to be a good contribution to the field of UD as both a method of teaching and learning and a means of practicing UD further down the road, when students have stepped into the real world and will have to deal with the concept at some point in their careers. As Galloway argues: "Since facts seem to end debates, and design seems to open them up, our greatest chance for critical invention arise [sic] in our engagement of shared concern – even if that means we cannot solve a problem" (Malpass, 2017, p. 131; cf. Galloway, 2007). Thus, the CDM is in line with contemporary design thinking, even though it aims to find problems rather than solve them.

More workshops in educational contexts – primarily within creative disciplines such as design and architecture, and preferably lasting two or more days – need to be held in order to see the whole picture. The discussions in plenum that followed each day of WS2 revealed that some of the scenarios given to the participants were felt to be too specific, making it difficult to truly 'design for all' rather than for a specific individual (this was particularly true for those scenarios that involved

personal assistive technologies). This was very useful feedback as regards revising the content and structure of future workshops, which could begin with the participants creating fictional settings based on Steinfeld and Maisel's 'Eight Goals of Universal Design'; body fit, comfort, awareness, understanding, wellness, social integration, personalisation, and cultural appropriateness (Steinfeld & Maisel, 2012). These could then be developed into suitable CDEs, and in so doing the participants would gain valuable experience of developing fictional settings (fictional people and environments), drawing on Grudin and Pruitt's "personae" which, when used correctly, constitute a powerful design tool (2003, p. 1-15). Moreover, they would obtain insight *to* and practise *of* utilising theory in practice.

An alternative approach would be to take a step back and implement both the EDA and the CDM of WS1, although this would require the participants of workshops to be design students, which would mean losing the feedback of others. The eleven workshops and roughly 110 participants show that, regardless of background (be it textile design, industrial design, or occupational therapy), there is always something to be learned from the 'dark side' of design thinking. This is particularly true as regards the ways in which it challenges assumptions and preconceived ideas about the role of the physical environment, in the form of housing, products, transportation systems, parks, and so on, in people's everyday lives. Thus, WS3, which will take place in Belgium over the course of a full week and involve approximately 15 Master's students from the disciplines of architecture, interior architecture, product development, heritage studies, and urbanism and spatial planning is currently being planned (University of Antwerp, 2018). It will draw on the experiences of the previous workshops and lay the groundwork for those that will come after.

7   (IN PLACE OF A) CONCLUSION

Ultimately, the primary advantage of employing the CDM in design education programmes is that students learn how to think, analyse, and evaluate ideas, concepts, projects, and processes in a critical manner. In that sense, the CDM has many similarities with the 'analysis', 'synthesis', and 'evaluation' categories of Bloom's Taxonomy[4]. A secondary advantage is that the method allows students to temporarily move away from problem solving, focusing on asking questions instead of providing answers – finding problems rather than solving them (Dunne & Raby, 2013, p. vii). In addition, design students are provided with improved knowledge which can be applied to designing products and environments "for the greatest extent of users with heterogeneous abilities" (Zöller & Wartzack, 2017, p. 58). Thus, they have a broader understanding of the user themself as regards quality of life, for example. Furthermore, emotional satisfaction – in addition to the physical and material aspects of well-being – should be a top priority, for example, as a way to fight stigmatisation (Ibid., p. 55). Finally, but most importantly, students obtain hands-on experience of

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[4] These can be described in brief as follows: 'analysis' is critical thinking focused on parts and their functionality in relation to the whole, 'synthesis' is critical thinking focused on putting parts together to form a new and original whole, and 'evaluation' is critical thinking focused on valuing and making judgments based on information. For a more in-depth discussion, see Duron, Limbach, & Waugh, 2005, p. 160.

the complications that may arise if this aspect of design – "the 'dark side' of design thinking" (Torkildsby, 2014, p. 20) – is ignored. By turning pedagogy upside down, a new approach to teaching and learning about design is born.

Consider an increasingly multicultural world, shaped by humanitarian crises and the migration of people, and the fact that the population of 60-year-olds of this world will have doubled from its current level by 2050 (WHO, 2018). Based on this, we can conclude that many new design challenges will appear in the future with regard to our physical environment. These include: a) The difficult task of the housing design of the future, and the fact that it must allow individuals to 'age in place'; b) sustainability in the sense that everything, including workplaces, must be usable by a broader population; c) social justice, as 'design for diversity' as a mantra includes the concept of 'social justice for all' (WBDG, 2018). Hence, bringing alternative methods into education – and eventually perhaps into the ways of working of professionals – will likely help UD to develop as a discipline. This, in turn, will better equip designers to meet the needs, wants, and desires of an ever-changing and increasingly complex world, and so evolve as universal design thinkers. According to Malpass, "the [designer] allows for a greater critical manoeuvrability and means of progression into the future" by opening a discourse through critical design practise – which is, of course, complemented with a strong concern for ethics and aesthetics (2017, p. 131). This, then, was the intention behind the CDM workshop series; to emancipate and enlighten the next generation of designers. Moreover, creative and critical thinking must join forces to a greater extent than today in order to, in the words of Mickahail, "bring forth [the] creative innovation and problem-solving ideas needed in the 21st century world" (Mickahail, 2018). Amen, we say.

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