Transforming our World Through Design, Diversity and Education
G. Craddock et al. (Eds.)

doi:10.3233/978-1-61499-923-2-128

Bringing Human Diversity into Design Processes Through Empathic Modelling

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Abstract. Most products are developed while adapting to requirements from industrial production and logistics. To break that trend and design for people, we suggest focusing on those who put the strongest demands on the final solution. They cannot compensate for bad design solutions and are thereby, like sniffing dogs, guiding designers to meet peoples' needs. We always use a combination of empathic modelling and involvement of people with reduced functions to find new solutions to the problems a product is supposed to solve. We have used this method in the teaching of Universal design at different universities for more than ten years. The students find the exercises to be a very entertaining eye-opener leading to development of empathy for human diversity all while the level of innovation in their design work increase. To constantly make design students understand barriers that can occur due to bad design solutions we utilize a toolbox simulating different kinds of functional ability. It also includes a handbook that describes workshops, evaluation methods and design processes that can be performed using the tools. The goal is to guide efficient, innovative and inclusive design processes. By simulating diversity among people, the designer can interpret the needs of different users and use that as a starting point and for evaluating design solutions during the creative process.

Keywords. Empathic modelling, Design for All, Universal design, Inclusive design, Design thinking, User experience, User evaluation, Co-creation, Accessibility, User friendly, Packaging design, Product design, Easy to use, Design education

1. Introduction

United Nations estimate that there are approximately 650 million persons with disabilities in the world, or 10 per cent of the global population. The Convention of human rights reaffirms that "all persons with all types of disabilities must enjoy all human rights and fundamental freedoms on an equal basis with others" [1]. To be able to meet these requirements we need to know the needs of the users and also how we can engage designers and give them enough knowledge to meet those needs [2].

In a traditional design process, you start by considering existing solutions fulfilment of the needs of the largest group, the tolerant users, and then try to extend to reach as many as possible. With 30 years' experience from design processes accounting for people with disabilities, Universal Design projects, research and teaching in this topic, we suggest that the starting point in every design process should be to identify the challenging far ends of use and to start with the needs of the people that put the strongest demands

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on the solution (Figure 1). To teach this we have found that a combination of co-creation with demanding users, "expert users", together with empathic modelling exercises makes the students very engaged and leads to a higher level of innovation in their projects.

An example of an expert user can for instance be a person who has limited hand function. Tomas & McDonagh also found that empathic modelling could support more effective design outcomes by developing the students' insight and understanding [3].

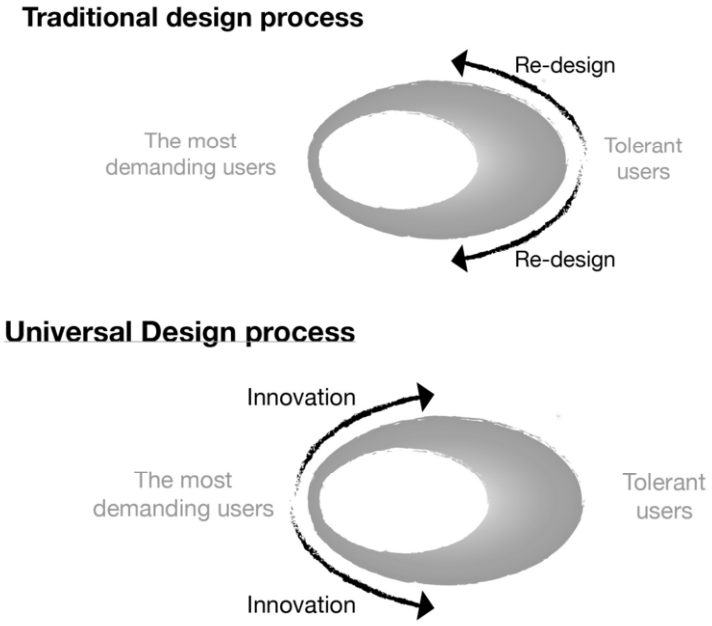

Figure 1. The shaded elliptical area represents the number of users. In a traditional design process, you start from an existing solution and often the designer's and similar people's needs. To create a more inclusive solution you then try to adjust it to include those who are "as me but a bit weaker". The outcome is often redesign of existing products inherited from industrial requirements. In a Universal Design process, we suggest that you change the starting point from "tolerant users" to "the most demanding users" and thereby reach innovations for a diversity of people.

There are several tools for empathic modelling on the market. Cambridge university has developed gloves and glasses as a part of the Inclusive design toolkit [4]. In a study made about how to give insight to designers and design students in inclusive design, the gloves were found a bit hard to use and expensive to buy [2]. The glasses give the user an exact experience of defined grades of limitation in acuity on the LogMAR-scale [5] which covers the main part of the population. They are made of paper and the lenses of plastic foil. The design is thin, so you can use several pairs on top of each other to simulate higher levels of reduced acuity.

Other well-known equipment are glasses from Fork in the Road [6], Zimmerman Low vision simulation kit [7] and whole-body suits such as "The Third age suit" developed by Ford [8] and the age simulation suit "Gert" from Product + project [9].

There are several digital simulators available online e.g. impairment simulator at the Inclusive design toolkit website [4] that also provides software to download for free [10].

Right now, there are also experiments using VR-glasses to provide a more three-dimensional experience [11].

We have practiced empathic modelling in the teaching of design students for fifteen years and used various methods, for instance taping coins on the knuckles to simulate arthritis. The taping was very time consuming (it could take two people half an hour to prepare a group of thirty people before starting the workshop). Using zip-ties instead of coins was more efficient. They were easier to tape to the fingers and could also provide stiffness in the wrist. Another example has been to simulate different kinds of reduced eye-sight by painting clear glasses with black acrylic colour and clear nail-polish.

Since these were hand crafted tools they were needed to be brought back after each workshop. The students could not continue using the methods that we promoted, and the long-term effect was lost. That problem was the starting point for the development of tools that could be mass produced in a cheap way, so that it is affordable for all students and designers. The tools are developed by the first author, and so far, consist of:

- Glasses imitating different kinds of reduced eye-sight such as macular degeneration, glaucoma, cataract, retinal detachment, diabetes, stroke, one eye and blindness (Figure 2).
- Gloves imitating rheumatic arthritis (Figure 3)
- Sound file imitating tinnitus
- Sound file imitating ADHD
- Instructions how you can imitate other reduced functions with everyday things such as tape, bottles of water, sticks, bandage, ear plugs.
- Process handbook

The aim of this paper is to share our experiences from using empathic modelling as an integrated part of teaching Universal Design. The paper is based on a workshop that took place as part of a one-week project course, where the empathic modelling toolkit was used.

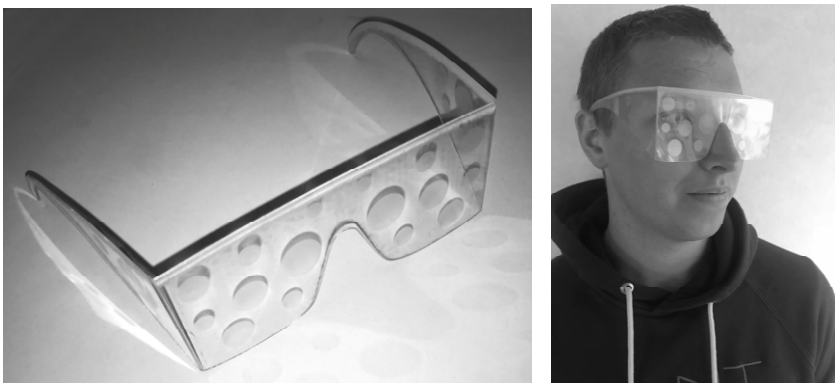

Figure 2. We have chosen to focus on different kind of reduced eye-sight since the needs, and thereby the design solutions, can differ [12]. This a sample of the glasses imitating diabetes.

Figure 3. The glows that imitate Rheumatic Arthritis has a plastic hand on the inside, positioned at the back of the hand, preventing the user to bend the fingers without experiencing stiffness and pain.

2. Method

This study was made with a group of 16 design students at University of Gävle in Sweden. This part of a course in Universal design focused on hand function (Figure 4). The design application was a half-litre water bottle since handling bottles can be difficult and annoying, especially for people with reduced function in their hands. They can experience a handling step, that for others requires some extra effort and patience, very difficult or even impossible.

2.1. Course design

2.1.1. Day 1

AM: Introduction workshop.
The course started by identifying the handling steps using a half litre bottle. The identified activity steps were: To grasp the bottle from the table, to hold the bottle, to open the bottle, to drink from the bottle, to pour from the bottle, to close the cap, and to put the bottle back on the table. (In this course, we did not go in to breaking the seal since it was such a short project and the models were mainly made from clay and an existing opening function with added solutions to improve the grip.)

In the first workshop the students worked in two groups putting words of properties supporting all handling steps and inspired by the words sketching ideas that make each activity easier to perform.

PM: Co-creation with expert users.
In the afternoon two people with reduced hand function participated, one with severe symptoms from rheumatic arthritis and the other with very limited hand function due

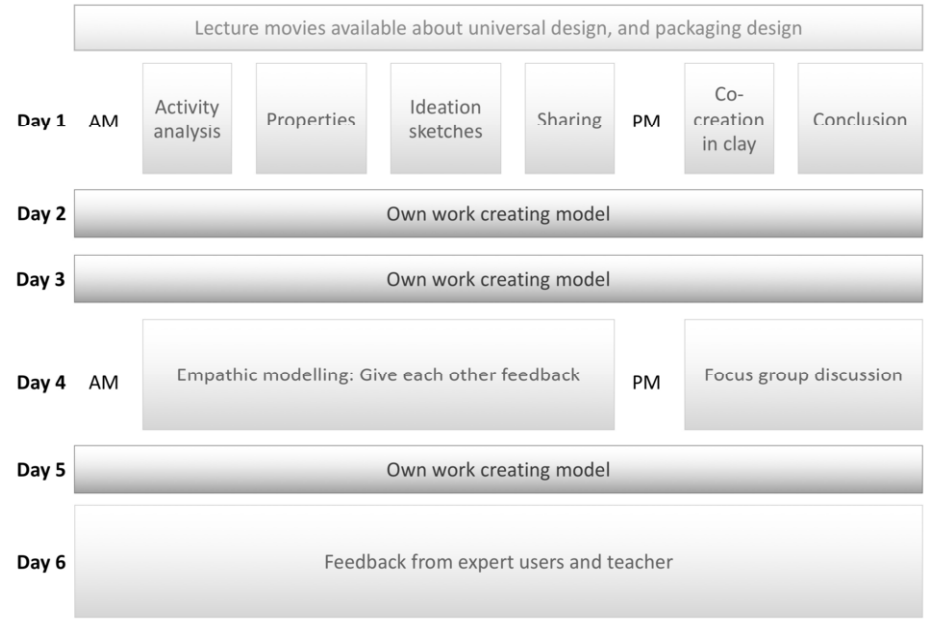

Figure 4. This picture show the course design. Lectures about the topic of universal design (what it is, why, how), how to design packaging that are easy to handle and information on diverse hand functions was given to the students by pre-recorded movies on internet.

Figure 5. The co-creation session where the students are sketching ideas in clay while they get feedback from the expert user with rheumatic arthritis and quadriplegia.

to quadriplegia from a broken neck in a car accident. The two groups had one hour with each of these two expert users where the students could get feedback while sketching their own solution of a bottle in clay Figure 5.

2.1.2. Day 2 and 3 Own work:

After this intensive introduction, the students had two days to develop functioning models before the empathic modelling workshop.

2.1.3. Day 4

AM: Empathic modelling workshop.
The equipment in the empathic modelling workshop consisted of: Glasses simulating cataract, macular degeneration, glaucoma, retinal detachment, diabetes, stroke, one eye, blind (seeing light and colours) and totally blind.

Reduced hand function was simulated by gloves imitating rheumatic arthritis, a combination of tape and zip-tie simulating quadriplegia and tying up one hand behind the back with elastic bandage simulating hemiplegia e.g. stroke.

Every participant could select what kind of reduced eye-sight they wanted to try and how their hand function should be reduced. Many students wanted to have one rheumatic and one quadriplegic hand to simulate the two expert users' experiences.

They brought their model/-s to the workshop area where the groups were placed on each side of a long table. Then they had a person to person evaluation and feedback discussion with all the members of the other group, five minutes each (Figure 6). Of course, they also had an opportunity to evaluate their own model.

The students were encouraged to continue keeping their reduced hand- and eyesight simulations during lunch to gather some more experiences in what impact this kind of limitations have on things they do in their everyday life.

Figure 6. Pictures showing the setup of the empathic modelling workshop. It was an intense and engaged interaction between the students while they were evaluating each other's models within a limited time span of five minutes before they had to change partner.

PM: Focus groups:
After lunch, there was a focus group discussion with each group of students where they discussed their experiences. The discussion was documented by sound recording, with permission from the students. The recordings were listened through several times and meaning bearing units were transcribed verbatim. The quotes were then analysed and grouped thematically.

2.1.4. Day 5: Adjusting the model.

After the empathic modelling workshop, the students had one day to adjust their model, due to the feedback they got during the workshop, before presenting a final concept for the expert users. The goal was that both expert users then should be able to use their bottle.

2.1.5. Day 6: Final evaluation with expert users.

Each student presented their model to the two expert users in front of the class. Both users tried to handle the model and gave feedback of their experience by "talking out laud" (Figure 7). Then students also got feedback from the teacher about possible improvements.

Figure 7. These pictures are showing how the expert users, with severe reduced hand function, are evaluating the students bottle models. All students reached the goal; that both expert users should be able to use their bottle.

3. Results

In the end of the first day, all students were amazed how far in the design process the had proceeded in only five hours. They were also surprised that all solutions were different although they started by sharing supporting words and ideas for the action steps.

The overall experience of the empathic modelling workshop was that "It was very interesting. It gave a great understanding". They all expressed that they had gained new insights and questioned their former picture of design "You got an insight, as well as when the expert users visited. You saw how they struggled but you did not understand the feeling until now. It´s as you often do when you design things, you think you know but you actually don´t have a clue".

It seems as if the process was taking them step by step to an understanding about design for human diversity. "Now I begin to get a feeling for the project. The first days it was hard to understand that I don't only have to relate to myself, that other people also should be able to use it." "In the first workshop, when we produced ideas, you thought it was in one way. Then the test persons came and now we tried this. It´s as if you get a lot closer to understand how it really is. So, this has been very fruitful". At the end of the

course, all students had reached the goal that the expert users should be able to handle their model.

To only involve expert users is maybe not enough. Watching someone struggle with a product design does not give the whole picture of the problem. "It's another experience trying out the limitations yourself compared to watching the test people. Of course, it also looks difficult, but this experience made me understand that it is more difficult than I could imagine. It made me understand the problems with products and what you need. Your needs are totally different." There seems to be a need of physical input and bodily engagement that common user studies cannot deliver, that can be bridged by empathic modelling. "You used both your brain and your hands, which gave a more complete feeling".

One student who made a model that had a really poor design got feedback that inspired her to make a conclusion that reflects a core value in Universal Design: "I designed my bottle with only one grip alternative. Then the other students tried it and turned it to find a good grip. And I did the same with some of the others' models. It was great. You need to rethink. Maybe there should not be only one way to grip a bottle?

An unexpected outcome was that the students experienced it easier to give each other feedback since "You have more evidence to discuss the shape. The critique becomes very concrete. If I can't grip it I can't. Otherwise you end up in subjective discussions, word against word." "It is much easier to give feedback in this situation since you are another person. It´s not just my opinion. I cannot grip it and then we discuss that further.".

The students wanted to keep the equipment to use them in the further development of their models and were very inspired after the workshop "Now we want to continue, we know what we shall do".

4. Discussion and conclusion

Simulated impairments could never give a realistic impression of how it really is to have these limitations [13]. Nevertheless, as noted in a similar study with students [14], the insights helped the students to get a better understanding of the expert user's challenges after having own experiences.

The process starting with the needs of the expert users by co-creation, continuing with empathic modelling and finally getting feedback from expert users was very successful. All students reached the goal that both expert users should be able to use their final model. The fact that students could reach this goal within a week implies Universal Design, targeting "as many as possible", has potential to reach a more inclusive level by starting design processes based on "the most demanding users' needs.

Judging from the experiences and end results of the workshop, the empathic modelling toolkit seems to be of value for understanding and taking diversity into account in design processes. The aim has been to develop an equipment that is easy to use and affordable for empathic modelling during design processes, in education and design practice. Together with the handbook, describing workshops that ensures that this equipment is used in an including, non-stigmatizing way [15]. We hope it will inspire many design students and designers to make more inclusive solutions by developing products that are easy to use.

Being a designer brings power to augment and open new opportunities, but it is also important to realise that design can limit opportunities and force people into a vulnerable

position. The main result of the course was that the students got an insight that it is possible to design a product that meets human diversity and that it is the designer's responsibility to cater for inclusion, and not the user who should adjust to poor design solutions.

Acknowledgments

We are very grateful for the long-term close collaboration with the Swedish handicap organizations during the development of the equipment.

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