Thinking inclusion through making

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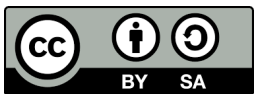

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Thinking inclusion through making

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ABSTRACT

Today we are witnessing the growth of bottom-up initiatives, innovative projects, and wide networks of people and labs engaged in a collective response to the environmental barriers and accessibility issues pervading our society, notwithstanding the huge effort in defining standards, rules, and recommendations for human-centric inclusive design. In this scenario, Fab Labs (fabrication laboratories) and maker spaces are playing a role as innovation labs both for their skills in rapid prototyping and as participatory design spaces involving people who can bring various skills and expertise throughout the development of human-centric solutions. This paper presents two design cases developed at the Fab Lab of the University of Siena, Italy, and offers a reflection about engaging people with a disability in hands-on activities grounded on the making practice. In the cases, we adopted a particular stance on making based on co-creation and joint reflection. This approach, known in the design literature as "thinking-through-making," shows that cross-competence, collaborative teamwork, inspiring design contexts, rapid iterative prototyping activities, and joint reflection on intermediate prototypes are quintessential to scaffold participants' knowledge and creativity and to design innovative and inclusive solutions.

KEYWORDS

thinking-through-making, accessibility, disability, inclusive design, digital fabrication.

TALK

1 INTRODUCTION

In the past two decades, the diffusion of Do-It-Yourself (DIY) practice and digital manufacturing has emerged as a heterogeneous phenomenon with diverse actors (from amateurs to professional scientists, from local fabrication laboratories to wide online communities), methods and objectives that promote extended participation in science and innovation [2]. Such innovation in manufacturing enriches the traditional craftsmanship process offering new tools to express creativity and better compete in the market. It also makes the production process accessible for non-technical people, non-profit organizations, and educational institutions, who can be involved in distributed design networks and carry out innovative projects [3].

This phenomenon is centred in numerous fabrication laboratories (Fab Labs) existing all around the world, located in more than 100 countries, open to different stakeholders to drive collaborative bottom-up innovation[1].

This is an extremely variegated and articulated network of people, skills, knowledge, and technology dealing with several challenges from health, art, education, sustainability, employability, and inclusion, to cite an incomplete list.

Accessibility is a particularly promising area of application of digital fabrication technologies since they allow personalization of assistive devices, cost reduction, and creativity of solutions. MAKEtoCARE[2] is a contest launched in 2016 to support the creation and growth of innovative solutions to meet the needs of people with disabilities. This initiative is promoted by Sanofi Genzyme in collaboration with Fab Labs and educational institutions. Maffei and colleagues [8] promoted a research initiative to map and investigate the numerous experiences of healthcare innovation through collaborative making practices.

For example, Makers Making Change[3] gathers together makers, therapists, and people with disabilities to develop affordable Open Source Assistive Technologies. Tikkun Olam Makers[4] is a global movement of communities, launched in 2014 to create and disseminate affordable solutions to neglected challenges of people living with disabilities, the elderly, and the poor. In 2017, it launched a hackathon for the design of accessible solutions.

e-NABLE[5], Open Prosthetics Project[6], Hackability[7], and the other networks offer resources, skills, peer support, and crowdfunding opportunities to boost the innovation in the design for health and disability support. They also offer the opportunity to initiate a distributed production with laboratories around the world, supporting bottom-up models to innovate the healthcare system and the design of assistive devices.

In what follows, we present a research carried out at the University of Siena (Italy), where the Fab Lab facility was used as a co-design space with disabled people to run a series of different projects. Involving vulnerable people in the design process is challenging since, besides the definition of an ergonomic and functional solution, the designer has to understand the sociocultural context of use as well as the methods and spaces to guarantee an inclusive and respectful mode of participation. In the design cases presented in this paper, the Fab Lab facility was used as an inclusive co-design space to engage with the local community and allow people with diverse skills to join and contribute as equal partners in the design process. Throughout the activity, thinking-through-making proved to be a particularly successful approach in achieving equality, stimulating creativity, and joint reflection.

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1 https://fabfoundation.org/global-community/

2 https://www.maketocare.it/

3 https://www.makersmakingchange.com/

4 https://tomglobal.org/

5 http://enablingthefuture.org/

6 https://openprosthetics.org/

7 http://www.hackability.it/

The design cases offer a methodological reflection about accessibility and inclusion: how can we generate knowledge that enables people with disabilities to express their expertise and creativity to play a more strategic role in service and product innovation for an inclusive society?

2 DESIGN CASES

Thinking-through-making is a process where the experience and skills of people are exploited to drive embodied explorations of a future artefact. In his famous book "Making: Anthropology, Archaeology, Art and Architecture," Tim Ingold [5] explores the idea that the envisioning processes of makers and the materials they use are in a continuous correspondence coming through one another. This allows creativity to emerge from within an ongoing, improvisational process between makers, materials, tools, and the physical environment.

Materials, tools, and the physical environment play an active role in influencing the thought processes of the maker and vice-versa. The creation of objects flourishes from within complex and reciprocal relations between all these forces. This means that new artefacts are not produced from a ready-made decision taken onto the material, form, and function that the object is supposed to serve.

Rather a new artefact is generated, on the one hand, in the flows and transformations of materials and, on the other hand, in the imagination and the sensory awareness of the maker. Therefore, the act of creation is a moment where an interconnected network of relations is materialized.

Digital prototyping tools and spaces are ideal contexts to make thinking-through-making happen in a creative and participated mode. The design cases briefly described below are a testimony of such processes.

2.1 Smart jewels for deaf people

Quietude is an EU-funded project which provides solutions for deaf and hard of hearing people, addressing not only functional but also experiential issues like self-confidence, aesthetics, and personal sense of style in wearing accessories, including hearing aids [11]. Eight Deaf people, together with makers/engineers, designers, and Italian sign language interpreters, were engaged in a thinking-through-making process realized through various workshop sessions, where the experience of deaf participants was exploited to drive embodied explorations of future hearing aids (Figure 1). Twelve people with mild, severe, and profound deafness were then involved in a session to evaluate and critically analyse the project solutions [10]. After some iterations, the jewellery system was presented in an open exhibition targeted to the Deaf community in Siena. Around 50 people participated and tried out the jewellery, sharing comments and experiences. The system was later exhibited in public events, including Florence Biennale of Contemporary Art (Florence, 2017), Future Fest (London, 2018), Ars Electronica (Linz, 2018), Dutch Design Week (Eindhoven, 2018), and is currently displayed at the Ulm Museum at the exhibition "Transhuman From Prosthetics to Cyborg."

The project developed aesthetically rich jewellery for deaf people, which are able to filter and recognize environmental sounds of personal interest (e.g., my doorbell, my dog) and expressively notify the wearer of their occurrence through light, vibration, and shape change. The project output is a modular system that can be personalized in terms of input (sound to recognize), sound notification (light, vibration, or shape change), and appearance of the jewellery [9]. This is to accommodate diverse users' needs and preferences, as well as to adapt the device to specific usage situations (e.g., quiet or noisy environments).

The pieces of jewellery are produced with different materials (e.g., leather, textile), using a 3D printer and laser cutter, with custom-made printed circuit boards and electronic components (Figures 2-3).



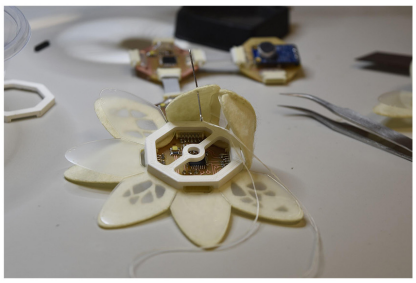

Figure 1: thinking-through-making with deaf people

Figures 2 – 3: fabrication phases

These accessories are designed to go beyond the functional goal of supporting hearing. Rather they fulfil emotional and sociocultural needs such as aesthetics, self-expression, and personal identity. This is one of the main requirements that emerged during co-design sessions hosted at the Fab Lab.
Low-fidelity prototyping sessions were conducted using paper, cardboard, and simple fabrics to enable participants to explore possibilities without being constrained by technical limitations. The emergent expertise enabled the design team to map out the accessory space. For example, while creating probes of jewellery, a deaf participant highlighted that hearing aids are usually designed to be as discreet as possible, with some sitting deep inside the ear canal, virtually invisible. This invisibility of deafness can lead to challenges in interactions. In social situations, hearing people can forget to attend to deaf people's needs and inadvertently exclude them. This reflection suggested adopting a counter-trend design compared to that of modern hearing aids, developing very visible jewels that can communicate deafness in an elegant and sophisticated way.

2.2. Inclusive hand weaving loom

Re/CREATE is a project for community engagement that aims at experimenting with practices of inclusive design and creative craftsmanship. In particular, the project designed, developed, and tested a hand weaving loom tailored to people with cognitive and sensorial disabilities. Our aim in the project was not to "compensate" for disability. We rather wanted to explore new possibilities for inclusion, selfhood, and community engagement to turn disabled people into competent design partners. Through a series of weaving workshops, a commercial loom was modified and enriched with semi-automatic functionality. Thanks to rapid prototyping and the involvement of disabled participants in the iterative development, the loom was augmented with additional features (e.g., flashing LED lights used as feed-forward mechanism) to enable disabled people to creatively weave on their own without the need for support. In fact, during the weaving process, the weaver has to remember which levers have to be raised or lowered. This task is complex and frustrating for people with cognitive impairments. In order to guide and make this task easier, a band of LEDs was located under each lever to indicate the levers to lower down (Figures 4-5).

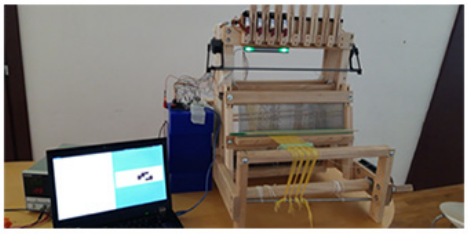

Figure 4: loom with flashing LEDs

Figures 5 – 6: a person with cognitive disability (left) and blind women weaving (right)

Moreover, a sensor was embedded to detect when the reed is beaten so that a servo motor raises all the levers and prepares the loom to repeat the task. This step proved to be necessary since disabled people often forget to raise up the levers after beating the reed and get stuck. The new automatic process of lifting the levers up was associated with augmented auditory feedback to indicate to blind users when the sequence was completed (Figure 6). In addition to the flashing LEDs, the prototype included 3D printed gates located near each lever to forbid the use of wrong levers.

The project developed through an intense phase of thinking-through-making activities resulting in the hacking of a commercial loom enhanced and transformed using digital fabrication technology. Six people with various types of disabilities, their caregivers, and weaving experts were engaged in a series of participatory design workshops focused on eliciting requirements and desires, inspiring the design process, developing and testing in highly iterative processes.

As an example of reflection emerged during a co-design session, a woman with a cognitive disability was particularly attracted by the flashing LEDs, which made her confident on when and how to perform the next step with the loom (Figure 5). Comparisons with another loom previously used emerged spontaneously. The woman remembered the embarrassment and frustration experienced when she did not remember the various steps, and this was a reason to give up.

3 REFLECTIONS ON MAKING FOR INCLUSION

The design cases presented above offer concrete experiences to reflect upon the importance of supporting and stimulating self-expression and creativity in people with special needs by engaging them in participatory design processes focused on thinking-through-making. We used the making practices as the basis for enabling collaborations between designers and other participants, adapting the activity to their skills and expectations. The combined use of various materials, including textiles, paper, cardboard, tape, pens, glue, and hooks and the use of digital fabrication technologies fostered the definition and transformation of prototypes, from low-fidelity probes to fully working systems. Participants were encouraged to fabricate their own personal accessory and suggest a specific solution. Ideas that emerged during the making process were materialized in the next prototyping iteration, moving from abstract and raw to concrete and structured. All participants appreciated to see their creation shaping as real devices along the process, and this encouraged them to take an active role and feel committed. It is worth mentioning that sometimes custom-made devices fabricated in Fab Labs are questioned because of their rudimentary and unpolished appearance [5]. In the cases reported above, the continuous fine-tuning of the solutions supported by product designers and the collection of participants' feedbacks throughout the process allowed to reach a good balance between functionality and aesthetics.

One of the strengths of the making process carried out in the Fab Lab was the possibility to ideate and customize the devices to meet emergent needs, as well as to support designers in adopting a holistic perspective on the user experience. The personalization of the product's form and features is particularly important in the context of a disability, considering that needs and preferences are dynamic, depend on specific situations of use and change over time.

3.1 Iterative development

The making practice is iterative by nature, with several cycles of exploration, ideation, prototyping, and evaluation. Unlike a linear production process, iterative design can quickly create diverse design alternatives, experimenting with different materials and levels of fidelity, to test and refine. In thinking-through-making with disabled participants, making and thinking alternate back and forth all the time, in rapid iterations. This supports the emergence of "frugal innovation", where small and low-cost adaptations are developed in a quick and easy way. In these quick iterations, the making or designing often takes place intuitively, and the value of any small adaptation relies on reflecting on what has been made to generate new knowledge and insights.

3.2 Cross-competence and co-design

The design cases presented above were carried out by multidisciplinary teams bringing diverse backgrounds, skills and points of view into the design activity. Of course, engaging people with different skills implies a suitable arrangement of the working space that hosts the co-design activities and a careful adaptation of the co-design methods.

For example, in Quietude, we arranged the workshop space ensuring proper sensory reach (visual and tactile) in 360 degrees to extending deaf people's awareness and making spatial orientation easier; arranging space and proximity to allow signers maintain enough distance to accommodate each other's signing space when conversing; maintaining clear visual communication while walking and conversing; avoiding shadow patterns and backlighting that disrupt visual communication; preventing acoustic reverberation that can be only distracting and also painful to deaf people use hearing aids or cochlear implants. All these architectural elements were accommodated to make the co-design space comfortable for deaf people. Furthermore, we experimented with different methods for engaging deaf people in the design process. However, not all of them were equally successful. For example, activities involving abstract thinking, like the one focused on reflection on ways of accessorizing the body performed in the first workshop of the Quietude project, were less engaging, while all making activities were extremely engaging, fun, and fruitful.

4 CONCLUSIONS

The research described in this paper aims to answer the following question: how can we generate knowledge that enables people with disabilities to express their expertise and creativity to play a more strategic role in service and product innovation for an inclusive society? We explored this question by starting a series of projects exploiting making as a central drive of doing research and design with disabled people. Taking advantage of the expertise and technology available at our university Fab Lab, we explored thinking-through-making as a primary source for inspiration and reflection on people's experiences. People with different kinds of disabilities, from sensory to cognitive impairment, were engaged in a series of workshops holding "making" in their core.

Participants were encouraged to reflect and share their everyday experience, materialize and transform insights into design probes, and contribute with their designed artefacts to the discussion within the design team, inviting all participants to be kinaesthetically engaged and to reflect together.

The vision of the approach is closely connected to reflective practice [12] and craftsmanship, where knowledge is acquired through the exercise of craft-inspired practices throughout design and fabrication processes [13].

One of the lessons learned from this approach is that engaging disabled people in the design process through making was a response to unmet needs. By listening and interpreting people's requirements emerged during making together, we could transform them into products that can be suitable and effective and at the same time desirable. This led us to design jewellery for deaf people and a hand-weaving loom to make the creativity of disable people flourish during the weaving process. In both projects, experiential needs like aesthetics, playfulness, gendered body design, and self-expression drove the design process from the very beginning of the design process. Both projects are still ongoing: while Quietude is more mature in terms of the number of deaf people engaged, in both cases, the participatory making practice proved to be successful, stimulating reflections and inspiring the process.

The practice of rapid prototyping to frame and address the problem space, inherent in the making practice, is a valuable, constructive research method for the design science [4, 6]. Indeed, it balances creativity and serendipity that are essential for innovation, with the rigour of the design methods for experimentation and evaluation.

Adopting a user-centered approach [1], we also learned that the solution to problems lies in an open dialogue with people with disabilities before any design work has been done. By working from "the niche," more universal designs can be developed to bring accessibility to the wider market. The artifacts we managed to design appear "ordinary" to the everyday eye, but in fact, they put the needs of a disabled group of people first. Our jewels are objects of desire for everyone, and the augmented loom proved to be useful and playful also for novice weaver.

Our hope is that this approach and solutions can be brought into the mainstream, too, as helpful, beautiful, and useful for all.

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