Tinkering with Disability. Using Electronics to Empower Families and Children with Disability

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Abstract
This position paper describes how to use tinkering thinking to help form creative communities comprising children with disabilities and their families. The pedagogical goals of such workshop activities is to boost both children and parents' sense of self-mastery and empower them to look at mundane life challenges differently, think differently about what can be done about them, and by whom. The strategic goal is to form a community that will sprout truly user centered ideas and eventually inspire new businesses within IT-products and services.

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ACM Classification Keywords
H.5 K.4.2 Social issues

Introduction
In recent years, the DIY movement has grown radically in number of followers and practitioners. Today, it is a movement, which inspires numerous businesses (1) and community based activities all over the world. In Denmark alone, the number of Fablabs and maker

spaces have grown explosively during the last three years. Further, design has recently entered the curriculum from 4th to 9th grade in the Danish school system.

Today, we are no longer looking solely at a Do It Yourself movement that aims at individual activities, but also at a Do It With Others (DIWO) phenomenon that encourages the collaborative innovative endeavours of several people. This practice is known as Social Innovation in the academic and design research community.

Using Social innovation to empower children with disabilities and their parents to be more powerful participants in their own lives, is what this proposal is about. This paper proposes growing a maker community through a series of simple construction focussed workshops using littleBits (TM) and set design assignments to help parents and children with disability look at mundane life challenges differently, think differently about what can be done about them, and by whom. One day, they might even help inspire new businesses based on their own design solutions.
But first some background as to why tinkering with electronics could radically change how this specific target group view and understand themselves and their possibilities in life.

The rising of the maker

Recent years' development of computer controlled manufacturing techniques such as laser cutters and low-cost 3D printers has provided a potential change in conditions for the production of goods. Numerous simple programmable interfaces have emerged too, such as the Arduino board, around which a community of millions of makers is still booming.

The maker world is not for adolescents and grown ups only. Many initiatives address young adolescents and children. In 1967, for example, Seymour Papert and colleagues designed the simple programming language LOGO specifically for educational purposes, and in 2002 the Lifelong Kindergarten Group at MIT Media Lab introduced the Scratch language to help children from 8-16 years of age think with computers. With Scratch you can program your own interactive stories, games, and animations, and share your creations with others in an online community. Other contributions include physical construction parts such as littleBits, which have offered anyone with close to zero programming experience the opportunity to play with sensors and actuators.

So where does it bring us, this combination of increased access to simple programming languages and semi-professional construction tools? One just need to take a look at various maker sites (see for example 3,6,8,9) to understand that making is hot, and appeals to men, women and children alike. And that people who create, explore and play with electronics use these skills to take control over their own lives, and make things that are useful just the way they want them to be. Such creative home made designs count tennis ball launchers for dog owners (7), biofeedback game controllers, (5) or automatic light switches (4).
The basis for all this creativity is to be found in the Jean Piaget's educational philosophy called constructivism, and according to quotes on for example MIT's Scratch website, parents and educators are thrilled. One parent is quoted to say "My very shy but technical minded

daughter has found this to be a fantastic, safe outlet for her creativity. She spends her free time creating ever more difficult animations and sharing them with the scratch community. The forums provide her with a group of like-minded individuals with which she can hold on a conversation... She now feels that computers, graphic design and animation are something she would like to pursue in the future. Your program has opened a whole new world to her in so many ways, and I thank you wholeheartedly" (10). Much in the lines of Gauntlett (2) and Sennet (11), this parent argues that not only is making a pleasurable and knowledge extending activity, making and sharing holds strong potential for being a social hub for children.

At Living IT Lab, I focus on using digital technologies to help people with physical and cognitive impairments experience better life quality. And one thing that is closely linked to our human understanding of a good life is the ability to take charge over our own situation. To produce something of interest to others, like the shy girl above. Or being able to throw a ball to your dog, play a computer game with your brother, or turn on the lights in your room. Terms like empowerment and self-mastery are, for obvious reasons, important concepts in the field of the physically or cognitively disabled.

Living IT Lab is a Danish publicly funded initiative to help bring IT and design knowledge into the field of human disability to help create products and services that will boost life quality of people with for example physical or cognitive disabilities. Such work might take many directions, one of which could be the development of welfare technologies such as robotic aids or apps that help children with autism remember their morning routine. Products like these function as add-ons to users' lives, seeking to help specific mundane activities. Quite another direction is what I propose here, namely that of tweaking the mindset of the user and their families, so that they become able to address the various little challenges daily life offers. This direction concerns bringing design thinking into the lives of the disabled to boost their experience of being in control over their own lives. Of being able to DO something about their current situation rather than wait for someone to invent something of interest. So, where the first direction addresses a specific use situation the second addresses the mind of the user, and this I propose to do through tinkering workshops for the children and their parents.

Workshop goals, both pedagogical and strategic

For the Nordichi workshop on tinkering, I suggest looking into the possibilities of creating environments where children with physical, cognitive or psychological disabilities together with their parents can come and learn about building small machines that do something useful or fun. Like throwing a ball, controlling a game or turning on the lights. The goal of such activities would be to make some of the valuable characteristics of the maker community available to these children and their parents, including:

1. a strong feeling of community with like minded people (not defined by a handicap but by an interest)

2. easy access to people who are more skilled than yourself and who can help and inspire you

3. the opportunity to inspire others and be a mentor to those who need help

4. and the amazing experience of being someone who can react to a need in everyday life and do something

5. to fix it.

The pedagogical goal of this proposal is not that children and parents should learn something specific about physics or electronics, but that they - through simple construction exercises - should gradually start thinking in terms of things that would bring them joy or help solve a specific little problem.

And then build it. Like a cannon that can blast tennis balls 30 metres when you push a button, a controller that reacts to muscle tension, or a light switch that reacts to you yelling at it. Such activities are expected to gradually lead to an increased level of self-mastery (as in 'because of this thing I built I can now do things I could not do before') but equally important, to lead to an increased awareness of own possibilities (as in 'because of this thing I built I can now do things I could not do before. Imagine what I might also do if I deploy my skills').

The strategic goal for the work described in this proposal is to help form a strong community of makers who can spot possibilities for improvement in their own (or their children's) lives, by own initiative prototype solutions and thus help create an open knowledge database where others with same challenges might get help, or where new businesses might grow out of design work that is truly user driven.

Discussion points

As discussion points I suggest talking about which simple exercises that would target novice designers with little or no construction experience, and help them identify various ways of, say, getting to the output that launches a tennis ball from a wheelchair. Exercises should also target various disabled users such as children with CP, Autism or Downs Syndrome, both in terms of complexity and in terms of usefulness in daily life.

Another discussion point concerns the use of the littleBits Intro Workshop as inspiration for this workshop. Is the setup described below a fruitful way to engage the target group and give them a feeling of accomplishment? What should be changed if not?

Workshop format and resources

The miniature workshop on Tinkering with Disability will entail simple exercises using sets of littleBits. With the aid of local Norwegian NGO disability associations, families with disabled children will participate in each group. littleBits is suited for children between 8 and fourteen, and attending children will be recruited according to that.

First part of the workshop will include exercises aimed at understanding what the different littleBits parts do, and how they work together, such as (examples taken from the littleBits web page)

"Construct a simple circuit with Power + Button + LED. You may use the LED or Long LED. When you press the Button, what do you see? Replace the Button with the Pulse Bit. What changes? What does that tell you about how the Button and Pulse Bits work?" and

"Construct a circuit using Power + Button + Buzzer. When you press the Button, what happens? If you

want the Buzzer to buzz off and on, what Bit to add or replace?

If you want to make the Buzzer go on and off faster, what should you do?"

Second part of the workshop will introduce design briefs and instructions based on the participating families' situation, and result in simple actuated machines that grow from tinkering with the electronics and materials provided. An example of a design brief theme could be to build something that launches a ball from a wheelchair. Participating families will get an understanding of sensor and actuator modules and what they do, a feeling of accomplishment and a small physical product.

Inspired by littleBits Maker/intro workshops (see, littlebits.cc/category/workshops) the Tinkering with Disability workshop is set to two hours, considering that - depending on the condition of the disabled participants - breaks need to be introduced which might add another 30 minutes to the workshop. The author will provide littleBits and design materials and tools to be used during the workshop. Such materials and tools include foam core, cardboard, glue dots, plastic straws scissors etc.

The author will arrange for the participation of the Norwegian families that are to take part of the Tinke With Disability workshop. Participating parents who speak English will be preferred in order to facilitate interaction with the NordiChi workshop participants.

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