

# **Mediating (nonverbal) communication between persons with different cognitive abilities using interactive artifacts**

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## **Abstract**

In a time of increasing interest in living and supporting life with mental illnesses, social design offers new tools and solutions for improving human livelihood and well-being. This paper presents student projects completed for a social design course in 2017 and 2018 at the Estonian Academy of Arts that combine traditional crafts with interaction design mindset and skills, resulting in social design work that tackles nonverbal communication with and between persons with different cognitive abilities. The paper compares the development processes of student work for a social design course from two consecutive years, sheds light on the project evaluations, future use in the real life context, and allows for a discussion of the future of design for social interaction between persons with different cognitive abilities mediated by interactive artifacts. The process of involving multidisciplinary instructors team and medical specialist into the design education process is described and reflected on.

## **Author keywords**

Social design; interaction design; textile design; e-textiles; crafting; touch-based interaction.

## Introduction: multidisciplinary social design

Electronics merging with traditional crafts as e-textiles in the context of social design have gained more interest recently. For example, touch-based interaction for visual impairment (Giles & van der Linden, 2014) has shown potential in the workshop setting. Giles created space for blind and visually impaired people to be able to create personal interactive art objects. Students at the California College of the Arts have learnt about social design by developing items for people with permanent movement disorders of cerebral palsy (Grant, 2016). Blumenkranz et.al. (n.d.) have developed a kit that would facilitate “the creation of made-to-measure e-textile and wearable interfaces for people with physical disabilities.” E-textiles have also been discussed in the context of cognitive development of people. In his PhD thesis ten Bhömer (2016) created a textile object with a goal to enable a dialogue between a person with dementia and his/her family member. Zhiglova (2018) discussed the socializing potential of the e-textile based interface from the Human Computer Interaction perspective by creating an interactive carpet for engaging with children with Autism Spectrum Disorder.

Opportunities of interactive textile based design for educational tools for children with various spectrums of alertness sensitivities were explored by Kuusk and Nimkulrat (2018). They discussed a social design course in spring 2017 in which the final year undergraduate Textile Design students at the Estonian Academy of Arts developed a set of interactive artifacts for the special-needs educators in the center of mental health of Tallinn Children’s Hospital. The first part of this paper reports on the evaluation of the same set of interactive tools after nine months of use and the second part presents the outcomes of the same course taught one year later. In spring 2018 a new group of undergraduate students of varied design specialisms, including textile, fashion, product and leather accessory design) collaborated with a care center for adults with a wide spectrum of cognitive disabilities to develop items for the center’s multi-sensory room (Long & Haig, 1992). A multidisciplinary team of tutors guided the student group: smart textile design-researchers, an HCI professional, a tutor from electronics workshop, and occasional feedback was provided by the care center employees. The students were encouraged to “learn to learn” – to develop the ability to learn from experience, to reflect, to self-regulate their learning, to take responsibility, and to assess themselves (Hummels & Lévy, 2013).

This paper attempts to reflect upon ways in which interactive artifacts may facilitate nonverbal communication with and between persons with different cognitive abilities after being put to work in actual environment with actual users. The paper retrospectively looks at student work completed during two consecutive years for a social design course and its future use in the real life context.

## Evaluation of the student work used at Mental Health Center at Tallinn Children's Hospital

### *Interactive textile-based design for education tools for children with various spectrums of alertness sensitivities*

Each year the social design project at Estonian Academy of Arts departs from a specific special education partner and their clients. In the spring of 2017 the students of Department of Textile Design brought their design artifacts that they had developed over the course of ten weeks for permanent use in the Mental Health Center at Tallinn Children's Hospital. Kuusk and Nimkulrat (2018) have described the process and resulting interactive artifacts with their motivations and references for developing qualities in detail. Below is a short contextual overview of the interactive artifacts.

**UUDU** (Figure 1 left) is a tool for color and pattern matching and texture exercises. Its soft hexagonal rotatable wheel divided into color and pattern sections was attached to the top part of the wooden panel painted in the respective colors and patterns, allowing color and pattern matching. In the bottom part of the panel there are rollers with interchangeable textures that allows for sensory awareness exercises (reaching, swiping, grasping).

**SHPACO** (Figure 1 middle) is a game for learning shapes, patterns, and colors. The surface is filled with soft switches of which each forms a pair of matching shapes, patterns, and colors. The child would find the pairs collaboratively with the instructor and lights would illuminate in case of the correct pair.

**TEKK** (Figure 1 right) is a multifunctional therapeutic blanket with weighted buckwheat sachets that could be altered and used in respect to the needed pressure or the function of the artifact. As a heavy blanket it provides anxiety relief. As a play mat it could develop balancing skills, mimic a massage, and arouse tactile senses. The herbal buckwheat pillows stimulate smell and tactile experiences.



**Figure 1.** From left: *UUDU* by Helen Grass and Irina Pommer, 2017; *SHPACO* by Maria Teng, 2017; *TEKK* by Kris Veinberg and Egle Lillemäe. © Helen Grass, Irina Pommer, Maria Teng, Kris Veinberg, Egle Lillemäe, and Estonian Academy of Arts.

After the academic evaluation, the work stayed in the Mental Health Center at Tallinn Children's Hospital for the staff and client's daily use. The next section

will present the user comments and ideas that have emerged after the artifacts had been in use for nine months in the center.

### *Evaluation of the nine months of use of interactive artifacts in the Mental Health Center at Tallinn Children's Hospital*

The previously described three works were delivered to the Mental Health Center at Tallinn Children's Hospital together with their accompanying digital video and PDF instructions of use. One staff member who is a special education specialist at the hospital was personally involved in the development process and took the initiative of introducing the works to her colleagues. The hospital staff member did not receive any specific instructions for documenting the use of the artifacts. They were informed about a possible follow-up request by the researchers in order to evaluate the long-term use of these artifacts created as social design course work. Nine months after the artifacts had been handed over one of the researchers contacted the hospital staff member for an open-ended interview at the hospital. The interview lasted approximately 1 hour.

The special education specialist at the Mental Health Center used the artifacts designed by the students continuously, in average 1-2 days a week. At the time of the evaluation *UUDU* was stored in her office where she meets her clients who are children with cognitive disabilities daily. She uses *UUDU* with a client whenever his/her cognitive level allows, mainly reaching sensory level communication. She used the different structures of *UUDU* and persuaded the client to attach and detach the textile surfaces on to the rollers with the Velcro. Children like Velcro in general. Some clients preferred arranging the patches, whilst some other preferred creating chaos with them. *UUDU* helped the clients who otherwise had struggled to maintain their attention. According to the specialist, *TEKK* was mainly used by the parents and a psychologist. She noted that the separate buckwheat pillows had been removed from the blanket to be used with smaller children. Sometimes they placed the pillows on the laps of the children, sometimes next to them. Children had also played hide-and-seek by using the sachets of the blanket. Therapists occasionally hid things into the sachets and children looked for them. *SHPACO* found less use at the Mental Health Center because the electronics had stopped working. It was also not working by the time of the visit.

According to the special education specialist, the items were interesting to the children during the nine months of use. As the clients saw and interacted with the artifacts maximum only once per week they have not lost their interest in the artifacts. Therapists also used the items in different ways, inventing new activities to play with the children. They alternated the use of the artifacts and in fact, the artifact was used only as a small part in the larger activity and goal of the session, so there was a lot of variety.

Over the course of nine months *TEKK* and its elements were used the most. Children found multiple ways of interacting with the artifact: building towers, playing pillow fight, and play hide-and-seek. Its multi-functionality generated the open ended and multipurpose use. It allowed for the creation of a mess or the organization of the space, which can be a very important exercise, particularly for autistic children.

Besides the therapists and other staff members, the items have been used by the parents of the clients. They are used for rewarding for evaluations and milestones.

For further development the special education teacher suggests to think of solutions for children to bring some of the educative tools back home with them.

## **Process of Designing Interactive Learning and Therapy Tools**

In spring 2018 the social design course started again with a new special education partner and their clients. In the course, the groups of textile, product, and leather design students collaborated with the Support Center Juks in Tallinn. The organization serves the Social Welfare and Health Care Departments of Tallinn. It offers social services to intellectually disabled people and supports people with special needs to cope maximally in everyday life, vocational trainings and working life (Tugikeskus Juks, 2018). The Support Center had recently started accepting people with autism spectrum disorders and proposed that the focus of the collaboration with the students would be on a sensory room for their autistic clients.

The duration of the course was ten weeks. At the start of the course the tutor briefed the group of students about the principles of social design, examples of the previous year's student work, and information about the specific special education partner. The context of autism and various spectrums of alertness sensitivities were new to all participants. The students could form pairs or work individually. Out of nine students enrolled in the course, three decided to work individually and six paired up forming three groups. Five of the participating students were of Estonian background and the other four students came from various places in Europe. In the second class the group of the students together with their main tutor visited the Support Center. During the visit the staff of Juks provided the students with an overview of the work and environment at the Center and gave a lecture about autism spectrum disorders and guidance regarding some main directions to follow. The students were briefed about the general safety issues concerning people with autism, for example to avoid sharp edges where the users could harm themselves. Throughout the course the students met regularly with the main tutor as well as an expert in electronic prototyping. The electronic prototyping consultations were added to the process based on the experience in the previous year in which the technical issue had become a fundamental issue for a therapeutic tool to properly function. The students had one feedback session with the staff of Juks midway of the project and a final evaluation in which the academic tutors, Juks staff as well as potential clients participated.

The following section will showcase a selection of student projects completed for the social design course in 2018. The authors selected the projects based on their differences in idea, functionality and execution.

## **Seven Prototypes of Interactive Learning and Therapy Tools**

Using the opportunities that textile and electronics can offer in conjunction with the needs of various spectrums of autistic sensitivities introduced by the

special education teacher at Juks, the students developed learning and therapy tools that the education specialists can use in their daily work with their clients.

### *Friendly Scarf*

*Friendly Scarf* acts as a huggable friend and is meant to calm down, relieve stress, and give a safe feeling to the wearer (Figure 2). It is made of soft velveteen stretchable polyester-cotton fabric whose texture invites relaxation and comfort. The scarf integrates six vibration motors that activate when a snap button is closed. It encourages the user to practice eye contact (as it can be a difficult task for some people with autism) with the dog-looking end. The scarf has several alternative ways of wearing: on the shoulders, around the neck, over the head, covering the back etc. The two sides of the scarf are of different colors.



**Figure 2.** *Friendly Scarf* and a moment from its creation process by Indrè Milašiūtė and Laura Rusanen, 2018. © Indrè Milašiūtė and Laura Rusanen, and Estonian Academy of Arts.

To finalize *Friendly Scarf* the paired students combined their knowledge in textile materials and tools, such as machine and hand sewing, with their understanding of e-textiles to integrate electronic components, such as vibration motors, Arduino, battery, wires, etc. onto a textile substrate.

### *TELK*

*TELK* ("telk" means "tent" in Estonian) is intended to be a calming space for the clients of Juks where they can relax and stimulate their senses by touching different textures. The students' creative intention is to give the user a feeling of staying under water. A projector LED night lamp fills inside the tent with calming ocean waves and sounds. The tent which hangs from a wall has 11 jellyfish. Five jellyfish are attached to the fabric next to the wall and six others to the fabric covering the other side (Figure 3). When touched the jellyfish vibrate subtly and show a colorful light.



**Figure 3.** *TELK* in daylight and darkness by Karolin Innos, Lisandra Türkson, 2018. © Karolin Innos, Lisandra Türkson, and Estonian Academy of Arts.

*TELK* uses traditional textile skills of hand sewing to work with soft materials in a variety of textures and surfaces such as fabric, leather, metal grid, velvet, synthetic fur and integrates various electronic component such as vibrating motors, LEDs, fiber optic cables, and conductive thread.

### *Moodi*

The stimulating game helps the client to learn and interpret the core emotions based on different facial expressions. This game consists of base faces and three facial parts of eyes, nose, and mouth. The user gets vibration feedback by finding matching couples and connected them. The elements are made of different soft textures such as cotton, wool and various types of fabric, using craft techniques such as hand sewing and crochet. The eyes are filled with dry rice and beans. Battery-powered vibration sensors are embedded in the fabric elements using conductive thread and conductive velcro to generate tangible feedback to the user. All related pairs can be attached to a blanket and used as a learning aid.



**Figure 4.** *Moodi* by Aylin Hackenberg, 2018. © Aylin Hackenberg, and Estonian Academy of Arts.



## Off Line

*Off Line* is a kit that helps people with anxiety to relax. Based on her personal experience the student observes how people act when feeling anxious. She noticed a behavior of tearing papers, tissues in the pockets, and in general the habit of touching and holding things (keys, phone, hairbands, coins, lighter, etc.) in the pockets. Inspired by that, she designed a kit of six small artifacts that fit into one's hand and potentially release anxiety. Two of the artifacts include electronic components. The artifacts have four different textures and shapes.



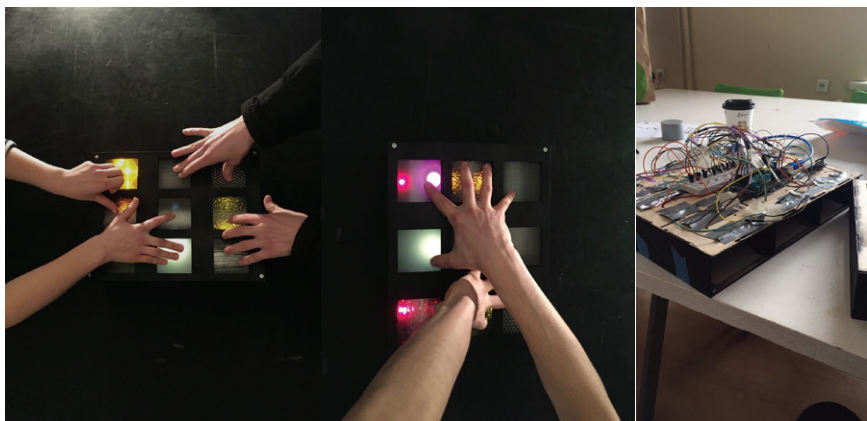
Figure 5. *Off Line* by Ann Mürsepp, 2018. © Ann Mürsepp, and Estonian Academy of Arts.

Materials of various tactile qualities were used to create *Off Line* including wool felt, foam, silicon, and Velcro. Programming and prototyping skills are important for the making of these artifacts.

## MoveColour

*MoveColour* is a touchable light-playing board for people with autism spectrum disorders. This product is for increasing their ability to concentrate and memorize. It is also a pleasurable help for creative thinking and self-expression. There are different ways to play with it: the client can play with it alone or with the teacher.





**Figure 6.** *MoveColour* by Julien Hac, Maarja-Liis Raamat, 2018. © Julien Hac, Maarja-Liis Raamat, and Estonian Academy of Arts.

Although *MoveColour* had used traditional textile tools such as needle, crochet hook, and sewing machine in its ideation stage, for its production it shifted to the use of digital tools such as Arduino, Solidworks, Illustrator, Indesign, Aftereffects as well as hard materials like wood and plastic and heavier tools such as the laser cutter, bandsaw, metal saw, metal guillotine cutter, handsaw, sanding machine, sandpaper, clamps, spray paint.

The skills the students pointed out that while the use of craft and digital skills are crucial for the execution of the project, soft skills including problem solving, communication, empathy, patience, creativity, and English proficiency.

### *Initial feedback from Support Center Juks*

While handing over the artifacts to the center Juks, the staff and clients were optimistic and hopeful about the new tools arriving to their sensory room. The students demonstrated each piece and left video as well as PDF instructions together with the artifacts to the center. The immediate feedback was all positive.

However, after 4 months sensory artifacts made of hard materials had been removed from the sensory room as the room had to accommodate some newly arrived over stimulated (aggressive) clients to calm down. These clients could harm themselves and/or others. Therefore, anything that might potentially cause injury became unsuitable for the sensory room, which is meant for people with a broad autistic spectrum. Generally, the staff of Juks saw soft sensory artifacts more beneficial.

The clients really liked *Friendly Scarf*, However, when the artifact was used constantly, it unfortunately stopped working rather soon – it did not vibrate anymore when the snap buttons were closed. *TELK* has to be removed from the space because the over stimulated client might harm himself and damage the artifact. *Moodi* was with a client to learn emotions; he found some of the

expressions funny. *Off Line* was used with some clients who liked or disliked the individual artifacts. The staff of the center did not get to use *MoveColour* after the presentations as it turned out to be a bit too complicated to start and play.

## Discussion and conclusion

The social design course at the Estonian Academy of Arts is an example of an interdisciplinary course allowing students in various design disciplines to learn directly from real life practice that opens up the applicability of their specialisms in a new context beyond what they are used to. By dealing with a certain group of users who may not be able to articulate how they feel about the design artifacts, students are challenged to learn to observe and be sensitive to information they have received.

The presented student work from the two consecutive years serves different target groups, however, follows a very similar design process of rough prototyping, discussions, iterative prototype refinement and presentation. The main tutor remained the same person. Additionally the second year included additional electronics tutor to assure the technical support throughout the project. The outcomes differ in their inclusion of electronic components (Table 1).

	<b>2017 project with Mental Health Center, Tallinn Children's Hospital</b>	<b>2018 project with Support Center Juks</b>
<b>Target group</b>	Children with different alertness sensitivities	Adults with autism spectrum
<b>Duration of the course</b>	10 weeks	10 weeks
<b>Instructors' expertise</b>	e-textiles + special education teacher from the center.	e-textiles + electronics prototyping + staff of the center.
<b>Works including electronics / total works</b>	1 / 3	5 / 5

**Table 1.** Comparison of the two Social Design courses at Estonian Academy of Arts.

Based on the nine-month evaluation of the 2017 project presented in the first part of the paper, technical issues arose in artifacts using electronics. The situation was probably due to the lack of time to refine the prototypes into a robust level, where they could securely work as products. As the items need gentle treatment or occasional maintenance (as can be expected from

prototypes) the context of mental health institutions might not be the best location for such items. The clients might not have all the sensitivity to treat the artifacts gently. The staff might not have the time or skills to maintain the artifacts accordingly. The authors hoped to improve the level of electronic solutions in the prototypes by involving an external electronics consultant but the works from the following year showed the same tendency when reported back after a short time of use.

Students quite often underestimate the time needed to complete a certain project. Also the short timeframe did not provide them with enough time for testing and refining the ideas before delivering their work to the client. The class could reach more finished and durable artifacts if the course lasted longer, for example 15-20 weeks. This would also allow more interaction with the partner institution to discuss, share and test the work in the actual context.

While the duration of the course is a key factor to achieved refined and durable prototypes, one interesting point that reveal in the 2018 course is the fact that several sensory artifacts had to be removed from the sensory room due to their potential harm to an over stimulated (aggressive) client. This is an important lesson learned for designing products for people with special needs. While each individual person has particular cognitive disabilities, designing for a care center and their clients mean that every single individual's cognitive ability and inability needs to be taken into consideration. An artifact designed for these people have to be 100% suitable for all.

The project has been a great real-life experience, to work with clients of extremely different backgrounds and various abilities. The students also enjoyed making social contribution and seeing their work in real use. Estonian Academy of Arts, Textile Design Department, continues to host a similar subject. In fact the collaboration currently running is in collaboration with Porkuni boarding school for children with special needs.

For the improvement of the multidisciplinary collaborative project between students and care providers, the long-term evaluation of the interactive artifacts mediating communication between persons with different cognitive abilities is essential. Items that beautifully seduce the audience during evaluation might have the opposite effect in daily life in care center and *vice versa*. It is important to understand, document and share the insights in order to develop more meaningful and useful developing tools. This social design course in the future may be designed in a way that a new group of students will have an opportunity to redesign or refine the prototypes that have been in use in either the Tallin Children' Hospital or Support Center Juks, generating a new design iteration that possibly results in a more refined and more durable products that serve their users well.

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