Applied Design Thinking LAB Vienna: INTERACCT. Interdisciplinary Technology Education in the 21st Century

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Abstract
INTERACCT is a project where two universities in Vienna (University of Applied Arts Vienna: Institute of Art Sciences and Art Education, Department of Design, Architecture and Environment for Education; University of Vienna: Faculty of Informatics, Computer Science Didactics and Learning Research, and Research Group Entertainment Computing), CCRI (Childrens´ Cancer Research Institute), children of an Austrian high school (Schulschiff Bertha von Suttner) and T-systems (a division of Deutsche Telekom, *systems* integration, computing and network services and e-business) have been involved within the Applied Design Thinking LAB Vienna from 2009 until today. Aim of the project is to enhance interdisciplinary and participatory approaches in design and technology education. Case study is design of an interactive web based communication platform for improving quality of life for the patients of the stemcell-lab department (SCT-INTERACT) and to improve medical communication and education in outpatient care after pediatric hematopoietic stem cell transplantation (SCT). Spin-off is design of a serious game where healthy and malignant children are participatory involved as well as the students of different teaching subjects (informatics, art and design education), the caring medical staff and the industry partner.

Interdisciplinarity as teaching competency at universities and schools

The twenty-century academy organized itself firmly around the concepts of diciplinary conceptual structures, problems and methods. Europe is considered to take a second life through the „Bologna process“ in setting intellectual standards for disciplines, scholars are tuning the contours of „the disciplines“ for the twenty-first century (Schneider 2010, xv). In inter/transdisciplinary work, practitioners must be able to cooperate with fellow team members and make referrals and offer educational services (Klein 1990, 150). The National Research Council (NCR) of the USA tracked series of research reports and announced that most significant growth in knowledge production in recent decades was occurring due to Interdisciplinary Design Research (NRC report 1986, 1990). Interdisciplinary Design Research (IDR) tracked developments that were promoting increased collaborations between life sciences and medicine and between physical sciences and engineering (Klein 2010, 17). “Members of interdisciplinary teams are, in effect, translating specialized knowledge into a “synthetic product“, acting as filters for each other, consulting experts, and the ultimative recipients of their work, whether they are students, patients, clients or other scholars“ (Klein 1990, 190). The dialectical framework enables integrate of material from different disciplines and provides in teaching and learning a liberal or horizon-expanding education.

Brenda Bannan-Ritland stressed in her study of professionalization of teacher education (TDR – Teacher Design Research) the importance of learning, “which can prompt teachers to reconsider their core teaching ideas, beliefs, and competencies. (...) the instructional aspects of TDR come not from outside experts”, but, rather from the teachers´ cognitive dissonance experiences as designers in design cycles.” (Bannan-Ritland 2008, 246)

Design thinking is an interdisciplinary method and can be described ”(...) as a discipline that uses the designer’s sensibility and methods to match people’s needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity” (Brown 2008). Its scientific origins can be found in the radical and social constructivism desiring to change society positively, focused on social or environmental items. The constructivist idea is the empowerment of the people, the participatory research with target groups, interdisciplinary nature, the plurality of diverse constructions, a holistic vision of our world, empowerment of critical questions etc. (Siebert 2005, 20). The process starts with “thinking out loud”, followed by iterating, creating and prototyping by having crazy ideas. In connection with designs for children as target group David Liddle (Liddle 2007, 244-251) proved that different methods have to be used: he suggested to work with the system of three phases (enthusiast, professional, consumer) to be more successful in structuring both the education and the practice of designing interactions. Instead of the formerly used user-centered or human centered design (HCD), in the 1990 participatory design increased to be today’s method (Schuler & Namioka 1993). Participatory design with children in pediatric oncology was applied and proved to be exceptionally successful (Vatne et al. 2008). The role of technology in communication design is discussed in Johannsen (Johansson et al. 2005, 3) from a general point of view and for children with cancer in Moe (Moe et al. 2007).

Keeping these examples in mind it seemed quite natural to start cooperation between art and science education and computer science education. Due to the fact that in both disciplines communication plays a major role it seemed interesting to start the cooperation with this topic. Designing communication systems requires nowadays high expertise in information and communication technology for future art and design teachers and for computer science teachers artistic aspects of communication play a vital role.

As an application case communication between malignant children and medical staff in a hospital was chosen. It should be mentioned that interdisciplinary work is hardly found in Austrian high schools, hence the idea is rather innovative for the Austrian school system.

Communication in Design & Technology: Machines as intermediary objects of communication

In our case we were interested in supporting communication between malignant children and medical staff in a hospital using actual information technology with interfaces, which meet user’s

needs and fulfill quality standards of design theory. In a first round the different views of communication design were discussed and a common understanding of the languages in the different disciplines was developed. Art and design focus more on problems, shapes and various solutions, while in computer science main emphasis is on functional aspects of communication using a computing device as intermediary for communication between humans. Although these approaches look at the beginning quite different there exists considerable overlap in the area of interface design. Design theory developed by Alexander and others (Alexander et Al. 1977) is also popular in IT (Tidwell 2006).

Based on this common understanding for both disciplines the communication problem under consideration was analyzed for defining initial requirement specification. The challenges in this project are the complex communication process, involving patients, doctors, psychologists, physiotherapists, teachers, peers, nutrition consultants and social workers, in particular in the time after hospitalization Main requirements for the solution is helping the children in reporting details about health status and social problems. Besides these operational goals the planned (virtual) environment should support communication with friends and offer the children opportunities for leisure activities. An additional problem was the fact that a number of children have different native language than hospital staff.

From the discussions three different approaches evolved emphasizing different communication requirements. One group focused on a solution with mobile devices using as communication metaphor an avatar-mentor. A second group concentrated on a so called house metaphor realized with notebooks, and the third group was mainly interested in using nonstandard haptic interfaces for communication. The joint work of students from art, design and from computer science allowed examination of the three models from artistic and technical point of view over two semesters.

Metaphors of Communication:

(1) "Avatar-Mentor"
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Christoph Hecht, Yavuz Ilkay, Manuel Kofler, Sophia Mairer,
Andrea Reithofer, Johannes Schenk, Erdogan Tugba Martin Krikl

The avatar-mentor should accompany the children as friend and authority, communicate in difficult situation such as not drinking enough or having forgotten to measure the blood etc., disappear when problems are solved and remind when something has to be done. Research was done by students, regarding their own "avatar experiences" in childhood and a fieldwork made with school children. Students proposed to use an "egg" as a basic shape for designing proportions of the avatar-mentor. In order to find out which characteristics influence trust in an avatar a questionnaire was designed asking children about their favorite appearance for the avatar, in particular basic shape, clothes, colors, accessories, hair, profession, age and gender. The survey was done in a research center for tutoring with 52 students (22 male, 30 female) between 8-16 years old. Conclusion: The basic shape "Egg" was accepted by 73% of the research participants. With respect to age and gender the most popular combination was "young woman"; 70% voted for this combination. The selection for cloth seems to be very much influenced by fashion, television and gaming. Fashion colors: red, blue, green, orange also violet and turquoise. In April 2011 a second more elaborated avatar survey was done with two case studies regarding avatar sympathy of 180 children at the age of 11-14 at a public school in Vienna, Austria. Further on existing avatars were tested regarding their evoking sympathy. Girls especially preferred animals as avatars or female avatars.

Participatory Design-Research was used by the means of involving children to design avatars for ill children. The briefing was the same for all: The avatar should accompany children, suffering from cancer and the drawings were interpreted with the methods of art psychology. The signs for evaluation of men (baby, puberty, adult) were assessed as well as specific symbols of age and accessories. Their characters were either differing in age or gender and one was developed as an alien.

Based on these results, a graphic designer developed avatars. These again were tested and evaluated by healthy and sick children. One must assume that sick children may have totally different preferences and this target group has barely been researched.

The interface is supposed to be understood with a "desktop metaphor", graphic symbols (buttons, toolbars) and nonverbal communication because many of the patients do not speak German. They should be motivated through easy handling. Surfaces, colors and forms should be easily personalized, and changeable. The application should work for users of all age. Facility requirements were: self-descriptiveness, simple controls, adjustable to every individual user environment, learning promotion; "drag-and-drop", "quick access"-systems. Some of possible icons were designed. Classic client-server architecture will be suggested and it will be designed in changeable modules for future solutions. The patient should be able to communicate with his medical support team easily by using his or her Smartphone. The patients should keep a diary. The medical mentor-team can have a quick survey of data of the patient and will be alarmed in case of irregularities.

(2) "House"

Seyma Aksoy, Lisa Baumgartner, Anna Grossmann, Esra Kacar, Andreas Roncat, Anna Hatice Özgan, Weninger, Desheng Wang, Katharina Weisssteiner

Spatial representation of information by using the metaphor "house" is very close to a virtual reality concept. The research focused on how one can design a virtual reality for the patients and which benefits can be driven, by using "house" as a metaphor. Children with SCT, with a weak immune system, isolated for month from their environment could imagine to obtain "their house" anywhere in the virtual world, which gives an impression of intimacy and protection (Pfister 1998).

Students researched on motivations for movements in virtual realities. The main points were considered as "achieve" and "relax" (Pasch 2008). Also important was the research of virtual environments for motor rehabilitation, which proved no flight from reality (escapism) or behavioral disorders associated with addiction (Holden 2005). Further on different already existing realizations of the metaphor were they evaluated PiNiZoRo: A GPS-based Exercise Game for Families (Stanley et al. 2010)

The first design was a "house" for a target group of 8-14 year old girls in a colorful pleasurable form and similar to MadTV with corridors and doors. Similar to the hospital, doors should lead to the medical team members The final design of the house project ended up in a virtual environment looking more like an estate with a number of building blocks for the different medical attendends, family and friends. The walkways between these buildings represented the different communication channels between the child and his support team. The main idea of the group was that these pathways adapt according to the mood of the patient and offered also a number of games in order to bring a child into good humor. Necessary data collection about health status is done in the different virtual rooms in an interactive way and the system responds to the user by presenting summaries of the status. For support of physiotherapy an interface with a Wii controller is forseen. A typical application scenario looks as follows: The child starts the system and a mood barometer pops up asking about todays temper. A door opens and the child can start a walk through the estate. Depending on the answer to the mood barometer the pathways have different appearance and lead to the doctor's door. Here the child has the opportunity to write a message to the doctor and look for advice. After passing this station the child is guided to the door of the diet assistant and gives a report about last meals. According to the diet plan an answer is given how to plan next meals and a bonus game is offered. The next station is the physiotherapist's world. Here a motion game is offered for improving physical conditions.

This application scenario shows that this proposal offers a conceptual approach for a rather complete solution of the problem and cannot be realized within one course. An interesting feature of the concept is that it allows monitoring of all patient activities and stimulating desired behavior

from medical point of view. A prerequisite is development of an appropriate data model for collecting all information and a design strategy supporting all functionalities. It turned out that interaction of computer science students and design student was very fruitful. They made a first concept for the data model and experimented with different programming environments for the interface. SketchUp, Flash and Scratch were used for prototyping.

(3) Haptic Interfaces

Teresa Auer, Cornelia Bast, Debora Däubl, Ines Jorda,
Bettina Hochrinner, Adna Karabeg, Hubert Stadler

This student group focused on a group of children at the age of 13+, having migration background. Contacts to children's peers reduce significantly with illness; after treatment they do not appear "cool" as a matter of skin problems and appearance in general, especially at the time of puberty. Hence, most of the patients fight against their illness as lone warriors and have low social contacts. In case of migration background the situation is worsened many times due to lack of knowledge in German language. Therefore the students decided to work on communication tools with other malignant children using communication devices with non-verbal haptic interfaces. Touch is very rare for them because of infection danger and uncomfortable feeling regarding their skin rash. Moreover the solution should motivate children by fun-factors and awarding communication.

So the students were eager to find something to satisfy their needs. They did research on happiness and motivation as well as how to praise their effort. One of the results was to design something collectable, because children love that. They did workshops to discover preferences of sound and haptic qualities. The collectable objects should be haptic and esthetically interesting, should have a small number, could be redesigned, should have a notional value, exclusive just for patients, and should be identified easily with the hospital. These objects should motivate to build up contacts, could be easily exchanged and should not be related to praise system. The children should enjoy with greatest possible independence. For technical solutions the group studied in detail nontraditional interfaces (Kortum 2008)

As a result ceramic prototypes of egg-like objects with different internal functions were produced and supplied with textures, which could be easily disinfected and cleaned. The egg-like projects have interactive sensors and should be charged by means of magnetic fields, induction. When force is applied on the objects, measured by sensors and signals can be sent and received. Light signals are reproduced, dependent on the force applied. Signal input may be performed through shaking, caress, pulling or pressing. Through the patient's own initiative an abstract language, secret codes can be invented. A primary coil of transformer is installed on the basic unit, secondary coil at the other objects. Iron cores of the transformer are placed next to the coil, transmission of energy possible.

Lessons Learnt

For designing interactions future art and design teachers need expertise in contemporary information technology. Besides the design of mainly functional structures, the superstructure of story lines, avatars, visual effects, motivational aspects had to be designed by the future art & design teachers in interdisciplinary teams. Working together in teams student teachers in design and computer scienece got first experience in interdisciplinary work. Technical basics and possibilities were communicated and the students even switched from their domain disciplines: art & design educators started to design with easy usable programs and IT students started to draw avatars for a research questionnaire. In particular Scratch was completely new for design students and it was impressive to see how one of the design students started to get totally involved with the IT world and started to program with SCRATCH (http://scratch.mit.edu/).

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