

Interactive applications for children with hearing impairments: A process of inspiration, ideation, and conceptualization

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ABSTRACT

In this paper, we describe the research and conceptualization process in which a design team aimed at creating a number of innovative concepts for interactive applications for hearing impaired children, in order to improve their quality of life. The design team experimented with various ways to include hearing-impaired children and their parents and teachers in this process. First, an inspiration phase was organized in which two field researchers used various ethnographic methods to gain a better understanding of hearing-impaired children. Next, the design team held two ideation sessions, which resulted in 13 concepts. After thorough evaluation of these concepts with all stakeholders involved, three concepts remained. One pedagogical concept was chosen to elaborate further on with the target group and is currently under development in a new research project. The paper ends with a series of recommendations for design teams focusing on hearing-impaired children.

Categories and Subject Descriptors

K.4.2: Social issues – *Assistive technologies for persons with disabilities*

General Terms

Design

Keywords

Hearing impairment, participatory design, assistive technology

1. INTRODUCTION

Empathy has become a key concept in design theory: understanding the experiences of the user is seen as an essential resource in the design process [5]. To learn what kind of experiences the design team should support, it is essential to thoroughly understand the issues faced by users. For some target groups, it is especially important as well as challenging for design

teams to reach a sufficient level of empathy. This is certainly true for target groups that the design team is rather unfamiliar with, such as users with disabilities. A disability can critically influence a person's experiences and perception of the world in a way that researchers and designers may not readily understand [9]. In this paper, we look into how a design team learned to understand the everyday lives of hearing-impaired children, and what it means to live with a lack of auditory input. We will discuss how this understanding was used to create concepts for new interactive applications.

Hearing-impaired children are a challenging target group for design teams. Not only is it harder to involve children in a design process rather than adults [6], the fact that these children are deaf or hard of hearing creates an additional distance between the targeted users and the design team. Although most hearing-impaired children today have hearing aid or a cochlear implant, they do have special communication needs. Technology enables them to communicate orally, but only to a certain extent. Often they miss a fluent mother tongue, which results in a lack of written and spoken language skills [7]. Many research and design techniques are based on a shared verbal or visual language. Therefore, the lack of written and spoken language skills, which is common in children with hearing impairments, has an impact on how they can be involved in the design process.

The goal of the research described in this paper was to generate ideas for interactive applications for hearing-impaired children. The choice of an application domain was not determined beforehand, and was entirely based on the needs of the target group. After an extensive 'inspiration phase', ideas for concepts were generated that could improve the quality of life of hearing-impaired children ('ideation phase'). Finally, a few concepts were selected for further elaboration in the 'conceptualization phase'.

In this paper we describe the three phases mentioned above. We finish with recommendations for researchers and design teams who wish to involve hearing-impaired children in their research.

2. INSPIRATION PHASE

In the first phase of the research, the inspiration phase, several ethnographic activities were carried out to map the world of experience of hearing-impaired children and to involve the target group in the research and design process. Two field researchers, who were part of a design team that also included designers and developers, did these ethnographical activities. The inspiration

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phase has been described in more detail elsewhere **Error! Reference source not found.**, therefore we will only briefly discuss it here.

The approach of the inspiration phase was highly pragmatic and was set up in close collaboration with an institute for hearing-impaired children in Belgium. The school psychologist, the teachers and caregivers were frequently involved in specifying the research plan. The institute also helped with recruiting participants. This fruitful collaboration resulted in a flexible and pragmatic exploratory approach, where the researchers made use of a wide range of methods including expert interviews, observations and creative sessions.

In a first step, the researchers gathered lots of information by observing the children during class and leisure situations, and by talking to their parents and experts. In addition, the researchers wanted to interact with the children themselves in order to increase their understanding of the children's world of experience. To that aim, the researchers participated in a summer camp for hearing-impaired children and organized three creative sessions.

From the interviews and observations, the researchers had learned that verbal information processing and reading comprehension is a challenge for hearing-impaired children. Also, they often have difficulties with fantasy, storytelling and abstract reasoning. By organizing creative sessions, the researchers wished to gain a more thorough understanding of this problem, especially to further empathize with the target group.

The three sessions were held with children from five classes, ranging from 7 to 12 years old. The children were shown six fragments of their favorite TV shows or movies, which they were asked to rate. Then they had to choose their favorite fragment and create an ending to that story by drawing what would happen next on a large sheet of paper with six frames (or three for the younger ones). As such, the children could express their narrative capabilities by drawing a story and using little words.

While most children did in fact not create a new ending to the fragment they had chosen, some amazed their teachers by exhibiting their fantasy skills. As such, the creative sessions not only served as a method for the researchers to increase their empathy with the target group, but also served as a trigger to have further discussions with the teachers, school psychologist and the sign language interpreter. To a certain extent, the sessions had challenged their own beliefs, which further nuanced our understanding of the target group.

The inspiration phase was an intense experience for the field researchers. Learning to understand a completely unfamiliar target group involves the absorption and interpretation of large amounts of information. They realized that it would be quite a challenge for the rest of the design team to fully comprehend the abundance of information gathered about the target group. To facilitate the design team's empathy with the target group, it was decided to involve the rest of the design team in the inspiration phase by sharing research journals and photos via a private blog. The blog was intended to gradually enhance the empathy of the design team with the end users, to stimulate engagement of the team, and to increase their feeling of commitment to the project [11]. However, the blog did not have its intended effect. Hardly any member of the design team read the posts or left comments, despite frequent reminders. When asked why, some team members mentioned they did not know how they could contribute in this phase of the project. Others said they did not feel involved in the project yet, and therefore did not make the effort.

3. IDEATION PHASE

The goal of the second phase, the ideation phase was to translate the insights of the inspiration phase into ideas for new interactive applications. In this phase, it was important that all members of the design team had a thorough and correct understanding of the target group they would be generating ideas for. To this aim, we developed a new ideation technique that we called the 'relay idea generation method'[2]. This technique was applied in two subsequent workshops with the design team: an empathizing workshop and a brainstorm workshop.

3.1 Empathizing workshop

As a result of the lack of effect of the blog, most team members knew very little about the target group. Therefore, the aim of the first workshop was to immerse the team in the world of experience of hearing-impaired children. In order to suit the creative process of the design team [1][8], themed posters were used rather than a research report to present the findings of the inspiration phase. These posters showed facts, photos, quotes, stories, etc. representing the results from the field research. During the workshop, the two field researchers guided the rest of the design team through the posters, elaborating on the topics of the posters and enriching the information with anecdotes and personal experiences.

To help the team members to further step into the world of experience of a child with a hearing impairment, the two field researchers moderated an empathy exercise. The design team was split up into four couples. Each couple consisted of one team member with a technical background and one team member with a background in design or behavioral sciences. They received a template to create a fictitious character representing a hearing-impaired child, based on the information that was presented on the posters. Elements of this template included 'Needs & wants', 'Problems', 'Dreams' and 'Diary entry'. Because of the large differences within the target group, basic demographics of four types of hearing-impaired children were already included in the templates. Two characters were completely deaf; two were hard of hearing. One of the deaf children had a hearing family; the other had a deaf family. Two of the four children went to a special school; one of them lived at the school during the week.

The creation of the characters turned out to be a good exercise for the team to empathize with the target group by elaborating on the information in the posters. All couples actively used the posters and asked the field researchers for further clarifications. Much effort was put in the creation of the characters, which resulted in quite elaborate and realistic descriptions. Each couple presented their character to the team and discussed the most important problems and needs. To finalize this first workshop, a list of all problems and needs mentioned in the character descriptions was created. The discussion on the list was at the same time used by the two researchers to correct a few minor misunderstandings about the research findings they presented.

Even though this empathy exercise was done very carefully, it is not unlikely that a certain bias resulted from reinterpreting the original data. In all cases, the original data had been interpreted twice: once by the field researchers, and a second time by the rest of design team. In some cases, when a sign language interpreter had been involved in the inspiration phase, the information from the hearing-impaired children had even been interpreted a third time. Even though the field researchers corrected some misunderstandings at the end of the empathy exercise, it is most

likely that their understanding of the target group was biased too. We will come back to this issue later.

3.2 Brainstorm workshop

The aim of the second workshop with the design team was to generate ideas for new interactive applications. Now that the design team had a better understanding of the target group, they were asked to use their insights creatively.

This workshop took place in the same room as the first workshop, about a week later. The posters, the character descriptions and the list of problems and needs were still in place and as such still visible for the team. Again, the group (including the two field researchers this time) was split up into couples (five), this time for an ideation session. To enhance the creative process a concept template was created. This template consisted of four blank boxes that were titled: 'main problem', 'solution', 'technical concept description' and 'fun elements of the concept'. Each couple started by choosing and describing in the first box of the template one of the problems or needs identified in the first workshop. After this, the templates were passed on to another couple and the couples tried to describe a (non-technical) solution for the problem that was chosen by the previous couple. After this, the templates were passed on again and each couple tried to think of a concept for a new interactive application that might provide the solution described on the template they just received. Finally, after another exchange of templates, each couple reflected on the solution and the concepts by indicating what elements would provide a fun experience for the children (based on the idea that fun is an important part of a child's user experience [10]).

This process of circulating a concept template proved to be a thought-provoking method. Because each couple had to think of different elements of the concepts (problem, solution, interactive application, fun elements), the task never became boring. The participants were continuously spurred and stimulated, because each couple constantly received surprising input from another couple. Neither was the exercise too difficult, as a couple did not have to think the whole solution through: they could just think of the next step and then literally hand the rest of the problem over to the following couple. When taking into consideration some of the well-known disadvantages of classic brainstorming techniques [4], working in a group of two persons and circulating ideas also proved valuable for other reasons. It allowed the team to work asynchronously and thus generate more ideas, it avoided members of the design teams to fear harsh criticism and made 'free riding' behavior harder. Using this method, the design team generated thirteen concepts in one hour.

In the final part of the ideation workshop, each couple chose one of the concepts that appealed most to them. Using a lot of scrap material, each couple tried to design a creative artifact representing the concept they chose. The aim of this exercise was to reflect on the concept in more detail in terms of functionality, interaction, design, etc. Using creative materials for this purpose stimulates participants of such a creative sessions to think-by-doing, which affords unexpected realizations that one might not have arrived at without creating a concrete artifact (or prototype) [3]. In fact, during the creative sessions, new ideas for elaborations of the chosen concepts were generated.

As mentioned before, the participants were well aware that due to the repeated interpretation of the original data, the outcomes of these workshops were probably biased. Therefore, after the second workshop, the thirteen concepts that emerged from the workshops were first presented to a technical team, which was

asked to express their opinion on the originality and feasibility of the concepts. After this, eight concepts were selected. These were then presented to the experts associated with the institute for hearing-impaired children that participated in the inspiration phase. In addition, a second institute was contacted to provide feedback, because the field researchers had learned during the research phase that the view on the problems of hearing-impaired children can be very different amongst institutes.

In the end, two of the eight concepts were judged to be useless for hearing-impaired children. From the remaining six concepts, three concepts were deemed to hold enough potential for further development. One concept envisioned a 'reading companion', that improves and facilitates reading comprehension of hearing-impaired children by making use of enriched, annotated texts. This generated a lot of enthusiasm at both institutes, and the researchers chose this concept to develop further.

4. CONCEPTUALIZATION PHASE

By choosing one concept, the project gained a new, more specific focus that required the researchers to do additional fieldwork and workshops to gain a better understanding of current reading practices and educational methods used to improve reading comprehension of hearing-impaired children.

A number of reading classes were observed; both in special schools as in regular schools, where hearing-impaired children received additional classes to improve their reading skills. These observations improved the researchers' understanding of the challenges that surround this problem for the children and were used as additional input for a first user scenario of the concept in the form of a storyboard. This storyboard formed the starting point for the first of two workshops that was held with teachers in the conceptualization phase.

4.1 Storyboard workshop

The storyboard that was based on the additional field research served a double purpose: it (a) was a first attempt to combine the observations with the selected concept, and to envision a future scenario that the design team could iterate upon; and (b) served as a tool that makes use of a common visual language that can be used by people with various backgrounds to discuss the design of a new application [13].

The storyboard introduced two characters: a teacher and a hearing-impaired child that attends classes in a special school but might soon go to a regular school. The original storyboard contained 11 scenes that were presented on paper to a group of teachers at one of the institutes involved in the research. First they were asked to go through the storyboard individually, and comment on the aspects they liked (using green post-its) and did not like (using red post-its). The comments were then discussed together. The storyboard sparked a lot of discussion, and three hours turned out to be insufficient to discuss the full storyboard. The storyboard got a thorough update after this first exercise. It was however also clear for the researchers that the process of annotating texts, and in particular the type of annotations that were needed for hearing-impaired children in order for them to understand a text completely, required more discussion. To have that discussion, a second workshop was held.

4.2 Annotation workshop

The goal of the second workshop with the teachers was to come to a better understanding of the types of annotation and a categorization of the annotations that are needed to enrich a text

for improved reading comprehension for hearing-impaired children. To this aim, the teachers were given a school text and were asked to discuss and write down in groups of two persons what information they would add to every sentence. Subsequently, this was discussed in group. Notes of what was being said were being made on a whiteboard. Next, the researchers tried to cluster the information that was given, together with the teachers. The workshop ended with a commonly agreed categorization of types of textual annotations for hearing-impaired children that the reading companion application should support.

After these two workshops, the original concept for the reading companion for hearing-impaired children was further refined. It is currently under development in a follow-up research project.

5. DISCUSSION & RECOMMENDATIONS

At various moments the researchers have interacted with the children that form the target user of this application. Both during the inspiration phase and during the concept phase, (participative) observations were done. While scientific literature was also consulted, it was especially the interviews, observations, informal conversations and creative workshops with the children and their parents and teachers that resulted in highly valuable inspiration and input for the ideation phase. One could say they served as better tools to create empathy with a target group with which nobody in the design team was familiar.

In conclusion, the researchers would like to give the following recommendations to researchers and designers who wish to involve hearing-impaired children in a design process:

(a) Hearing impairment is a sensitive matter. Parents, teachers, scientists and pressure groups have very diverging opinions of how a hearing-impaired child should be treated. It is important to be aware of these sensitivities and to take them into account in your interactions with the target group. Collaborating with special schools or other institutions for hearing-impaired children is essential, but try to involve at least a couple of organisations to ensure a diversity of opinions about hearing impairment.

(b) Because of their condition, children with hearing impairments are closely monitored by many medical experts and are also the subject of many research projects by speech language pathologists. There is high demand for research cooperation, which has caused organizations for hearing-impaired children to be somewhat careful with respect to participation in new research projects. Be sure to extensively illustrate the added value of your research project.

(c) When working with a design team, reserve sufficient time to make sure the whole design team can empathize with the target group. Also make sure to double check the understanding of the target group, in order to avoid misunderstandings.

(d) When working with hearing-impaired children, researchers need to be extra careful for possible biases in their understanding of the target group. The information gained is often obtained via teachers, parents, caregivers, and specialists, and then being reinterpreted by researchers or the design team. These repeated reinterpretations can result in distorted perception of the users.

(e) Since children with impairments are in general more protected from outsiders than other children, it is easier to involve only parents or teachers in the design process. To avoid a confined perception of the target group, it is however valuable to look for ways to interact with the target group, no matter how challenging, to get a first hand understanding of them to some extent.

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