How to Carry Out Usability Studies with Visually Impaired Children

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ABSTRACT

Usability tests help us obtain quantitative and qualitative data with real users who perform actual tasks with a product. Usability tests were carry out to evaluate a designed product for a Student Design Competition (SDC). The following document relates the process of adapting usability tests to visually impaired children, who were the target audiences in a project. In interaction with children we learned how to help children understand some concepts involved in the product faster. This interaction resulted in a reliable device whose characteristics fit directly with user's needs.

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Figure 1: Diagram describing the development cycle according to the UCD-e methodology.

CCS CONCEPTS

• **Human-centered computing** → **Usability testing**; **Usability testing**; *Laboratory experiments*; **Usability testing**; **Accessibility design and evaluation methods**; *Laboratory experiments*; **Usability testing**; **Accessibility design and evaluation methods**; **Accessibility technologies**; *Laboratory experiments*;

KEYWORDS

Usability testing; visual disability; prototype; UCD-e; accessibility.

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INTRODUCTION

In 2017 took place CLIHC (Latin American Congress of Computer Human Interaction by its initials in Spanish), the topic for the SDC (Student Design Competition) was the visual disability. The different usability congress around the world carry out SDC, which are contests to apply knowledge to help a vulnerable population. Currently, visual disability is a condition that cuts off or limits people from doing their day to day activities and affects their quality of life. Acording to BMJ, in 2010, 0.02% of children between 0 and 14 years of the world population suffers any degree of visual disability, this represents 37.9 millions children with this condition [3]. Projects awarded with the first and second place of the contest, were develop in UsaLab at the Universidad Tecnológica de la Mixteca. The projects were developed using User Centered Design extended version (UCD-e) methodology and usability tests were carried out with real users, all of them with different level of visual disability. This paper illustrates what we learned performing usability tests with visually impaired children. Project YAMI focused on this group of children, therefore the results reported here come from this project. The objective was to develop a keyboard interface to facilitate the use of smartphones for children with visual disabilities [4].

METHOD

Methodology used for the development of YAMI project was UCD-e (see Figure 1). With this methodology there was the need to evaluate the designed device with real users, in this case children with visual disabilities. At the performing of the pilot test evaluation, there were not enough techniques and tools for the facilitator and the observers, thus a bibliography research was conducted on the

Figure 2: Development of usability test for a low fidelity prototype using good practices.

Figure 3: Development of usability test for a medium fidelity prototype using good practices.

topic and also we needed to contact experts in visual disability. From this information, we created a first compendium of practices to perform usability tests.

FINDINGS: ADAPTING USABILITY STUDIES

Usability Studies or usability tests can be classified in formative tests. Those are realized during product development and have the objective to find and correct errors, based on small repetitive studies during the process. On the other hand, summative tests, which are done with the finished product where it is sought to perform the validation of this, generally requires a greater number for statistical validation. Depending on the testing approach is how the tests and tasks are designed and planned to be carried out [2].

Once the goals for the study have been defined and determined; the format and establishment of the study; the number of users; the recruitment of the right users; the tasks; the pilot study; the metrics; and the testing plan [2], now we can begin with the user-prototype evaluation. We identify our target users as children with different levels of visual disability aged from 9 to 16 years old, which is an average age where children begin to use smartphones.

The project required 3 iterations, in each one a different prototype was tested. The first evaluation was made with a low fidelity prototype and it was evaluated with 21 children, this showed us that praxis carried out was not the most suitable, because the language used was not adequate. We came to this conclusion about our expressions because when we asked the children to carry out a task it was unclear for them sometimes and we have to keep explaining what we wanted them to do. We also did not considerate spatial location and it also made use of ambiguous terms to indicate an object for them.

With these first considerations and needing perform a second evaluation to a medium fidelity prototype, we sought to improve the practices compendium for the tests, in this case the facilitator used new terms and discarded certain expressions.

The second tests were performed with 24 children, most of them felt comfortable during the tests, showing greater participation and understanding of the different tasks. In the second tests series was identified most of children did not know how to use smartphones, it was an unexpected observation, but thinking in our environment as one of the poorest states in Mexico, from the beginning it was considered to be explicit about the functionality of smartphones. Children knew other technological devices such as remote controls, televisions, radios, microwave ovens and toys which help us explain concepts of a smartphone functionality. For this reason, it was necessary to increase time of tests in order to explain the prototype operation with the smartphones.

For third iteration of the UCD-e methodology, a final evaluation was made with a high fidelity prototype, with real elements. In order to make the evaluation, the facilitators and observers had to improve the compendium. With this in mind techniques for approaching technology [1] were added,

Figure 4: Development of usability test for a high fidelity prototype using good practices.

additionally to experts observations and recommendations obtained in the two previous evaluations. In this third test, 21 children were evaluated, almost all children were able to complete their tasks and understand the meaning of these, and finally results obtained from YAMI evaluation were very well accepted.

Development of usability tests allows obtaining important data for the evaluation of the product, if these tests are not done properly the data may be influenced by other issues and the product's ratings vary significantly. In the case of usability tests with users with a disability it is important to consider all the variables, to adapt these tests and avoid this become a factor to influence the product data.

With the information collected in the usability tests with 66 users, an analysis was carried out that showed percentages about the effectiveness of the YAMI device. For a first prototype, there was an 83% acceptance, for the second prototype a 92% and for the Third prototype 97%.

Table 1: Results of the usability studies carried out with 3 different version of YAMI.

		Prototype	
Iteration	*Tasks*	*Users*	*Succes Rate*
1º prototipe	6	21	83%
2º prototipe	7	24	92%
3º prototipe	7	21	97%

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DISCUSSION

During the tests the Cognitive walk-through technique was applied, which allows the user to take a tour to explore the product functions. Thinking aloud Protocol technique was also applied, where the user is request to express all their opinions while testing the prototype. Once the steps mentioned above were followed, a set of good practices were implemented for children with visual impairment, some of them being [5]:

- Ask at the beginning of the tests to authorize the parents and the children to carry out the tests and, if necessary, to take photographs and / or video.

- Make the tasks comprehensible and appropriate to the case of children with visual disabilities, avoiding ambiguities, and be careful when using certain expressions and replace them with the correct ones, for example, this, that, and so on.
- Use other senses to help children complete the tasks we asked them, for example, in the case of users they needed more exploration by touch, which increased the time of each task.
- The facilitator would have to be more specific in location and time, that is, to guide them to where we needed them or give them the objects in the hands to facilitate the manipulation, you can use phrases such as, I will place to your left side the prototype, etc.
- Describe in detail the prototype, interface, environment, etc. and the task to be done. Also allow users to scan the device by themselves before starting the test, so they be fully familiarized with what they are about to test.
- If there is technology or concepts with which the user is not familiar, it must be related to other situation or objects that help the user understand how it works or to compare it with the functionality of something else.

CONCLUSION

Developing usability tests for children is a complex task. You should consider it interesting for them, and short enough to keep their attention and test each feature to evaluate. However, when we work with children with visual impairments, we notice that they are very interested in learning, and they like to explore for themselves when it comes to something new. Our users were children between 6 and 13 year old, most of them had not use a smartphone before, so we explained some abstract concepts such as navigating through a menu, opening an application and selecting an option. To explain this concepts, we related it to other technologies and situations according to the child's environment.

The usability tests provided YAMI with real information about the needs of visually impaired people and their problems with the interaction with mobile devices, each test was closer to solving the problem, and the evaluations at the end of each one provided the improvements needed. One of the significant aspects in each test was adaptation.

Although YAMI is a device that facilitates the use of mobile devices for visually impaired people and is aimed at children between the ages of 6 and 13, we also conducted usability tests on youth and adults, forcing the facilitators to change the type of language and how to transmit information.

As future work we want this compendium to be bigger, enlarging the age range, make it more inclusive considering all the people with disabilities, and also specifications for each needs.

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