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Applying UCD for Designing Learning Experiences for Romanian Preschoolers. A case study.

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Abstract. Living in a world where almost every aspect of our life becomes digital requires attention on the digital skills development of young generations of citizens. Education is the driving force that can support equality of chances in digital skills acquirement. In this paper we describe our experience in developing, with the help of Computer Science Students, educational software for Romanian preschoolers (3-5/6 years) attending the public formal educational system. To be successful, the educational software should be both accepted by preschoolers and their teachers. We propose a two steps User (Child) Centered Design (UCD) approach focusing both on preschoolers and their teachers. The results obtained by applying the proposed method on a real case study are presented.

Keywords: UCD · preschoolers · education · digital.

1 Context

The world surrounding us becomes more and more digital, and the new children generations are considered *digital natives* [8]. This falsely suggest that the children posses the digital skills required by the future European Digital Market [3]. Romania, as part of the European Union, ranks on the last position (28th of 28 countries) on digital skills assessment [4]. Interventions need to be done for the future generations, and the public formal educational system should be the leading part of the process. ICT classes are thought starting from primary classes until the end of the mandatory studies program. In the public formal preschool educational system, no measures for fundamental digital skills development are considered. Although every class room from kindergartens has a computer connected to the Internet, it is used solely to play multimedia content (most of the time youtube videos). This approach is not appropriate, as the same studies

[4] also show that Romanian citizens possess only the so-called *lifestyle digital skills*, but lack a vision of using technology to support work-related tasks. We consider that by appropriate interventions we can help the young generations embrace the technology as support in their knowledge gathering process and provide support on fundamental digital skills development. The form of intervention envisioned by us is the development of educational interactive products to support the classical teaching activities.

2 Method

Designing and developing educational applications for preschoolers brings two major challenges: designing for preschoolers and ensuring the educational nature of the products. The first challenge is determined by the lack of design guidelines for this particular age range. Although there is a large body of literature regarding designing for children, it focuses only on children aged 8 years or more [2], [5], [6], [7]. Romanian preschoolers are 3 to 5-6/7 years old. The important differences between preschool children and school children are the following: preschoolers cannot read or write, they cannot complete adult stated tasks without being rewarded and their main activity is playing. The second challenge, referring to the educational characteristic of the interactive applications, needs focus on the content presented, on the engagement it determines, and on the fundamental digital skills that are required to interact with. In order to achieve the educational goal, we knew from the beginning that the participation of an expert in children education is mandatory. We have required the support of a kindergarten teacher to guide and support us through the design stages. Gaining children acceptance of the products was equally important as providing the right content and interaction. We decided to also involve children in the design process. Our intention was to apply UCD, although our final users lack some cognitive and physical skills that would empower them to actively participate in all steps of the design process. We considered that they can still be represented by the kindergarten teacher which will replace them (being a *surrogate*) when necessary. We have involved in the design process Computer Science students from the Faculty of Mathematics and Computer Science, Babeş-Bolyai University, attending the Human-Computer Interaction (HCI) elective course. The students have worked in 26 teams of 3 to 5 members. The final goal of the HCI classes is to make the students aware of the importance of user focus during the design of products. We considered that our project suits the goal of the HCI classes. The only doubt we had was if the final products will be accepted by the children and by other kindergarten teachers, their acceptance being the measure of our products success or failure. Thus, we have imagined a two steps process of creating successful products: the first one we have called *product design* and the second one we have called *product validation*.

The *product design* was organized as an adapted UCD, in the sense that in some design steps we have replaced our users (preschool children) with a kindergarten teacher with the role of representing their interests. Thus, in the

requirements phase only the kindergarten teacher has participated by stating the curricula domains that will be targeted by the educational applications, the age range they address, the content (information) that should be presented and the tasks children should perform to gather the intended knowledge. Still, the children have been included in this step, as informants. The design teams have participated to observation sessions in the kindergarten to gather information about children knowledge about their project subject and their digital skills (verify if fundamental interaction skills are present: using the mouse, performing a click, drag and drop, key pressing: blank, enter). Each kindergarten class is composed of 26-30 preschoolers, such that members of each design team have observed and interacted with children groups. During the observation, we have allowed the members of at most three design teams to interact with the children, such that each design team has interacted with at least 5 children (of course, children were allowed to move between the students groups). At the same time, the design teams observed the children playing in the classroom. The kindergarten teacher required that all the phases in the teaching process (focus capturing, new knowledge presentation and fixation game) be covered by the applications. Also, she specified that the applications should be conceived as games or at least they should expose games-related characteristics in order to be suitable. After generating alternative design ideas, the kindergarten teacher has provided feedback on the designs and guided the design teams further in the process. Based on her feedback, the teams have built high fidelity executable prototypes. The prototypes have been evaluated twice: once by the surrogate user that gave feedback on the presented content, task order, task formulation, and second by the preschoolers. Individual play-testing sessions have been organized, followed by post-test interviews with the children. Each application has been evaluated by two children. The kindergarten teacher has been present during all user testing sessions to provide comfort and support to the little users. Peer tutoring has been used to replace think aloud protocols in order to assess how children have understood the applications. Satisfaction was also assessed by the use of smileyometers.

The *product validation* step was intended to check the opinion of other kindergarten teachers. We have considered that a positive evaluation would be a good predictor for the future intention of use. We considered that heuristic evaluation is the most cost and time-effective method. We have encountered the same problem as in the design phase: the lack of evaluation tools targeting preschool children educational applications. After researching the literature we have decided to adapt an existing heuristics set, namely Heuristic Evaluation of Child E-Learning (HECE) [1]. We considered it appropriate because it consists of three heuristics subsets referring to navigability, children skills and learnability. It was developed for children aged 10 or above. Twelve kindergarten teachers have participated in the heuristic evaluation. Each application has been assessed by two kindergarten teachers.

3 Results

During the play testing sessions the most frequent problem was that the children did not understand what is the goal of the application, because the applications lack an introductory part. This problem has been addressed by introducing characters that would welcome the children in the application's world, shortly presents the available functionality and how it is accessible, and guide them through the learning/interacting process. Another problem was related to task formulation. Initially, the tasks were stated using sentences like *select/find the object(s) ....* The children used to answer to these kind of tasks by pointing with their fingers on the screen. The solution was to explicitly state how the task is expected to be accomplished by saying *select with a click the object ....* Children were very engaged during the user testing sessions and they repeatedly played the proposed games. As the applications haven't been designed for multiple levels of difficulty, the children gave up using them when they became bored. Every child participating to the evaluation session has marked the happiest face on his/her smileyometer. The results of heuristic evaluation with the kindergarten teachers showed a large consensus on the children and learnability components of the heuristics set. All the participating evaluators agreed on these aspects, considering that the heuristics are successfully implemented. Regarding the navigation subset of heuristics, evaluators have identified problems about objects position consistency on the screens, lack of hints that would help children understand where they are in the application's space, interaction related terms that were considered too abstract.

4 Discussion

After having the experience of applying UCD for building educational software for preschoolers we can draw the conclusion that UCD is feasible even for such small age users. They can participate in every step of the design process, but the presence and support of an adult representing their interests is necessary in the requirements and alternative design evaluation steps. Although we did not involve the children in the alternative design evaluation phase, we consider that they could provide us new design ideas. Our decision was determined by the lack of time (the wireframes and sketches were too abstract to be understood by the children and too much time would have been spent to make the children understand and generate new ideas). The results of user testing show that children are eager to embrace technology during their learning activities as long as the learning experience takes the form of games or contain games-specific characteristics. The results of heuristic evaluation confirm the strength of participatory design: the kindergarten teacher participation during the entire design process has ensured a large agreement on the educational and children related aspects of the products. One drawback of our heuristic evaluation is that it was performed by colleagues of the kindergarten teacher participating in the design and a common organizational culture probably influenced the results. The presence of navigational problems may be explained by the fact that inexperienced developers have

applied their first interaction design project to a category of special users (with supplementary interaction constraints). We must specify that during their studies, the Computer Science students have experience in building command-line systems or Graphical User Interfaces used only by (expert) adults. This project has challenged the students in multiple aspects: focusing on the user, understanding the cognitive and physical constraints and identifying proper solutions, evaluating the final product based on criteria they have never considered before (usability, acceptability). At the end of the semester, many students have mentioned that the participation on this project was the best experience during their studies. It makes them feel like having a contribution in the development of younger generations. Moreover, one of the kindergarten teacher participating in the evaluation step has expressed her availability and intention to be part of the design process in the future.

We consider that by providing access to the developed products to a large mass of children we create the context for equality of chances in acquiring digital skills. The kindergarten from the public educational system are the most appropriate choice, as most of the children are attending it. The kindergarten teachers will have multiple ways of teaching the curricula content and children will have the opportunity to see different approaches to introducing the new content and to interact with the computers in a learning context. We consider that this way children will build the basis of their fundamental digital skills in an appropriate and engaging manner. Starting to build their digital skills from an early age, they have the chance of becoming the digital citizens required by the Digital Market European strategy.

5 Conclusions and further work

In this paper we have presented our initiative of building educational software for public formal preschool educational system from Romania. We have applied a two steps approach: an adapted UCD approach in the design phase and an adapted heuristics set in the validation stage. The results of the first iteration show us that our approach was worth the effort, based on children and kindergarten teachers feedback. In the future we need to evaluate the learning outcomes of using the interactive products in the educational settings in terms of domain knowledge and fundamental computer skills acquisition/improvement.

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