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Design of an inclusive & interactive educational textile toy

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Abstract. The market for educational toys is scarce in products specifically developed for blind and low sighted children, aiming not only at their motor and cognitive development as well as to the non-stigmatization of these children. Considering the development of educational toys, and based in previous research work [1], we found that textile materials offer an enormous application capability in this regard due not only to their flexibility in use and maintenance of properties, but also because of our familiarity with these materials.

The main goal of this project is the study of the emotional response to an interactive educational textile toy by children with visual impairments - blind or partially sighted. In this way the project is based on four main axes: knowing the user, identifying his specific needs; knowing the product-user relationship with a special focus on tactile and emotional perception; study textile structures to best fit the design; and, finally, evaluate the user's response to the developed product by evaluating the product experience.

1. Introduction

Children with visual disabilities learn to explore the world through the use of the remaining senses. In their growing and development it is of importance to provide them the chance to contact with objects, environments or situations that allow them to acquire multiple concepts, to diversify experiences and enable their cognitive and social development [2]. Playing is definitely one of the most important way through which children acquire these concepts and develop their capabilities [3]. In the particular case of children with visual impairments the toy can be an important vehicle in the children's development, through stimuli and through interactions with other children that can be conveyed by the toy [1].

These such as other children learn from the playful expression, and as so playing is the most natural form of self-learning. In general playing is a pleasurable activity, but when there is no pleasure in the activity of playing, a displeasure is generated and consequently the result is strenuous and unnatural. During their growth when playing, children develop their imagination and their potential and enrich their sociability [3], but this growth does not occur in the same way for all children. In fact, the deficiencies deprive many children to use their imaginative ability and withdraw development opportunities from them.

Each step in children development is vital for each future progress, for each daily achievement. Children need to continuously develop their sensory and social skills, and these must be continuously stimulated [2]. Educational toys for visually impaired children - whether totally or partially blind -



should cover the same areas and activities promoted for children in general, but above all should consider their particular needs, forms of resource usage and specific materials.

When analyzing the market for educational toys, we found that this is scarce in products specifically developed for blind and low sighted children, aiming not only at their motor and cognitive development as well as to the non-stigmatization of these children. In the other hand, textile materials offer an enormous application capability in this regard due not only to their flexibility in use and maintenance of properties, but also because of our familiarity with these materials. Textiles have always been a part of our lives, since birth we are used to these materials, they are safe, harmless and most of all they have mnemonic abilities.

2. Pleasure and product experience

Through design we have the ability to "formulate and formalize experiences", experiences that are build on both the aesthetic experiences that the object itself provides as in the experiences of use, that arises from the interaction and from the relationship that is created with objects, and that differs from user to user depending on the emotions the object evokes in each user [4][5]. With regard to the user experience, there is agreement in the literature that all objects are able, in a greater or lesser extent, to establish emotional relationships with users [6][7][8]. We also know that the creation of significant emotional experiences depends largely on the usefulness, usability and enjoyment obtained from the use of a product [6]. Therefore the pleasure obtained from the experience with the product also influences the performance in using that particular product, *i.e.*, pleasurable objects lead to better performance levels due to the greater predisposition generated by feelings created in relation to the object and consequently greater satisfaction in the final experience [6].

Thus, the objects ability to be attractive and to establish emotional relationships is important for the design of objects able to establish personal relationships with users. On the other hand, if the objects require user's attention focused on their use and if the user has confidence on handling the object within their capabilities, this leads to situations where the feeling of pleasure is increased associated to a peak in performance [6].

2.1. The role of senses

Touch is one of the senses involved in product experiencing. It is associated to a direct contact and proximity, implying the perception of object properties together with the perception of movements performed to explore it [9]. These peculiarities make the emotional component in product experience particularly important in regard to touch. These aspects stipulate how the user interacts with the product and are therefore crucial to its design, promoting the relation between the user and the object [10]. Due to the lack of consolidated theoretical basis and of quantitative analysis, user's emotional perception is often hardly considered in product development and the result are products that do not respond effectively to the needs of the specific user [11].

2.2. The role of textiles

The textile materials, given their characteristics and constant presence in the daily lives of children constitute themselves as materials with high potential to create pleasurable experiences. On the one hand due to the warmth touch, flexibility and diversity of textures, on the other due to its mnemonic capabilities of association with the mother skin and to the safety of home which in turn gives emotional comfort to the child [12]. Thus considering the ability textile materials have to establish affective relationships with the user, it is felt that these materials provide an excellent support for the development of products that will have a greater durability through affection.

Presently there is a great variety of interactive textiles available in the market. These offer the possibility to integrate sound and smell into the product, either through embedded electronics or by the use of encapsulated materials, as a reaction to a stimulus.

3. Objectives

Taken that when analyzing the market for inclusive toys, developed specifically for ages between 6 and 12 and that also aimed at the development of social abilities, we found that there is a very poor offer, and therefore we decided to create an interactive surface to be introduced in an inclusive “board game” for blind and low vision children. The intention with the project is for each child to be accepted as an equal in rights and duties and make use of toys suitable for children with or without visual impairments, contributing to the integration, socialization and inclusion of the visually impaired child.

This project seeks to evaluate the user's relationship with the product by assessing the perception of haptic properties at the emotional and sensory level, given that this matter is particularly relevant in the case of these children. Previous studies have already demonstrated the ease with which children with visual impairments relate to textile objects [1][13]. These works allowed us to conclude that in addition to the haptic qualities associated with the materials textures is also necessary to consider other sensory stimuli in the interaction with objects, which lead us to consider the interactive textile materials as priorities in this approach.

The project also aims to demonstrate that interaction through textiles offers interesting possibilities of application in innovative products.

4. Methodology

The work was developed based on inclusive design and human centred design principles.

The first stage of the project focused on the comprehension of the processes of concept acquisition and learning of these users. Specifically on understanding how through touch, hearing and sense of smell the blind child can perceive the object, as well as seizing or recognizing something familiar, like for example a smell or a shape. The study also aimed at knowing which sensations could be transmitted through the surfaces, in order to get an emotional response.

In this phase visits were made to educational institutions to observe these children and their interaction with others, and also to conduct interviews with professionals, like teachers and psychologists, as to obtain a deeper understanding of the children needs and explore possibilities for the product (board game).

At a second stage different textile surfaces and interactive textile materials were tested as to their ability to be used in the toy.

Finally the product was developed and tested in regard to the user's emotional and sensorial experience with it, by a pilot group of blind and low sighted children with ages between 6 and 12 years. This assessment was also accompanied by inquiries, facilitating a better understanding of the emotions observed.

5. Board Game design

Based on the interviews and observations made during the first part of the research work we have determined the following principles in which to base the design of the board game:

i) The game aims to develop visual, tactile and sound stimuli and allow its use by all children. This must be explored with the hands, in order to discover the different textures, recognizing forms, details and dissimilarities. The definition of the figures or drawings to be represented needed some care. It is important that these are simple and easily perceived by the child through touch or color, without great details that can be cause of confusion or doubts in understanding the elements presented.

ii) The product should have characteristics in common with the generality of the toys, but with some specificities and adaptations, in order to facilitate and better adapt its use by blind and low vision children.

Taken the above considerations the board game presented in figure 1 was developed. This board game has different textile structures in different game cells (Figure 2) and uses interactive textiles in some of these cells, such as surfaces that react with a sound if the players press the cell area or that have specific smell properties (like in cell 13 presented in figure 2, where there is a strawberry smell).

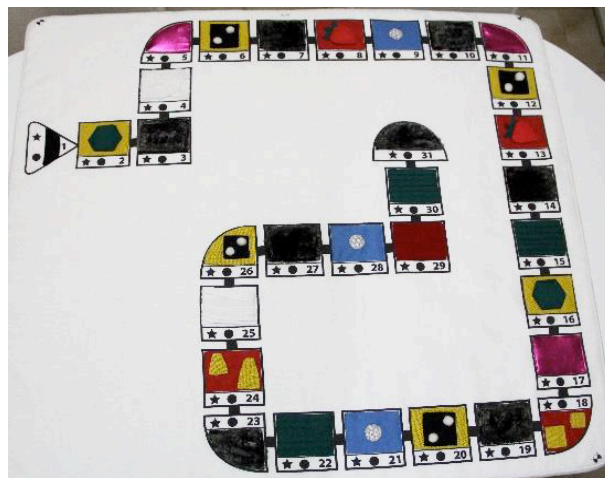


Figure 1 - Interactive Textile board game developed



Figure 2 – Detail of some examples of textile structures used in the development of the board game.

6. Results

The results of the observation period, combined with the interviews and the theoretical research supported the choice of textures, colours, sounds, smells, shapes, and other important features to use on the surfaces of the interactive board game.

The board game was developed including some specific features and adaptations to facilitate and better adapt its use by the blind and low vision children. It is meant for this to be explored with the hands, allowing the child to find out and distinguish the various textures, smells and sounds, recognizing shapes, details and differences.

Since it was not possible to get a significant number of children of the chosen age range to test the product, and since the product is still in prototype stage, it was decided to performed only exploratory testing. The board game was tested with a group of three visually impaired children aged between 6 and 11 years (Figure 3).

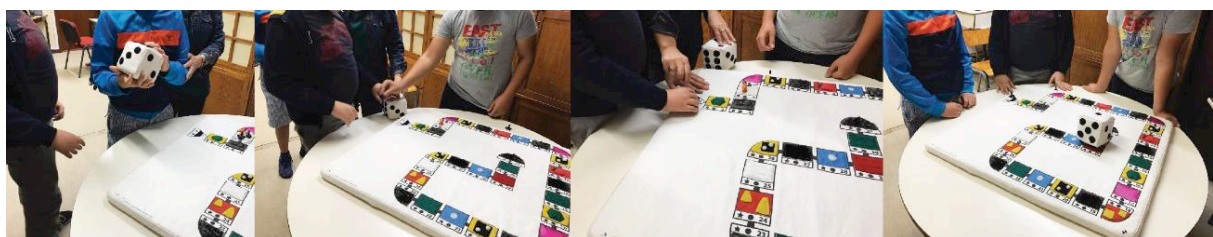


Figure 3 – Test stage: Children playing with the board game

In order to obtain a feedback of the product and although the evaluation was not filmed, observations were registered by the researcher and also by a psychologist who followed the whole process. The observations were registered in terms of the emotions expressed by the children during product use, the easiness/difficulties encountered, and general satisfaction/dissatisfaction.

Overall there was a positive product experience, with a significant level of emotional involvement of the users. In general the emotions elicited by the game were mostly joy, curiosity and enthusiasm.

7. Conclusions

This project emphasized the contribution of design to a more inclusive society, providing a knowledge of all the problems that involve the constraints faced by blind and low vision children.

The product has characteristics in common with the generality of the toys, but with some specificities and adaptations, in order to facilitate and better adapt its use by blind and low vision children, the design of the product was carefully developed, as this should also captivate normal children.

The first results point to a clear indication that textiles perform well in this type of applications. From the emotional point of view, positive emotions were demonstrated not only at the beginning of the game, but also along the whole course of play, being verified that the interactivity of the game has always led to a lot of enthusiasm, joy, curiosity and surprise by the children.

The product responded positively to the needs for which it was thought, being clearly inclusive since it enabled playing between children with low vision and blind children and it is believed that it would also enable these children to play with normovisual children.

Given the lack of fully inclusive board games that allow play between children with various types of impairments and not only those with visual impairment, it is considered that it would be interesting to develop other complementary studies taking also into account children with other types of problems, such as deafness, allowing a greater inclusion.

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